MAY 31, 1954

Electrical World

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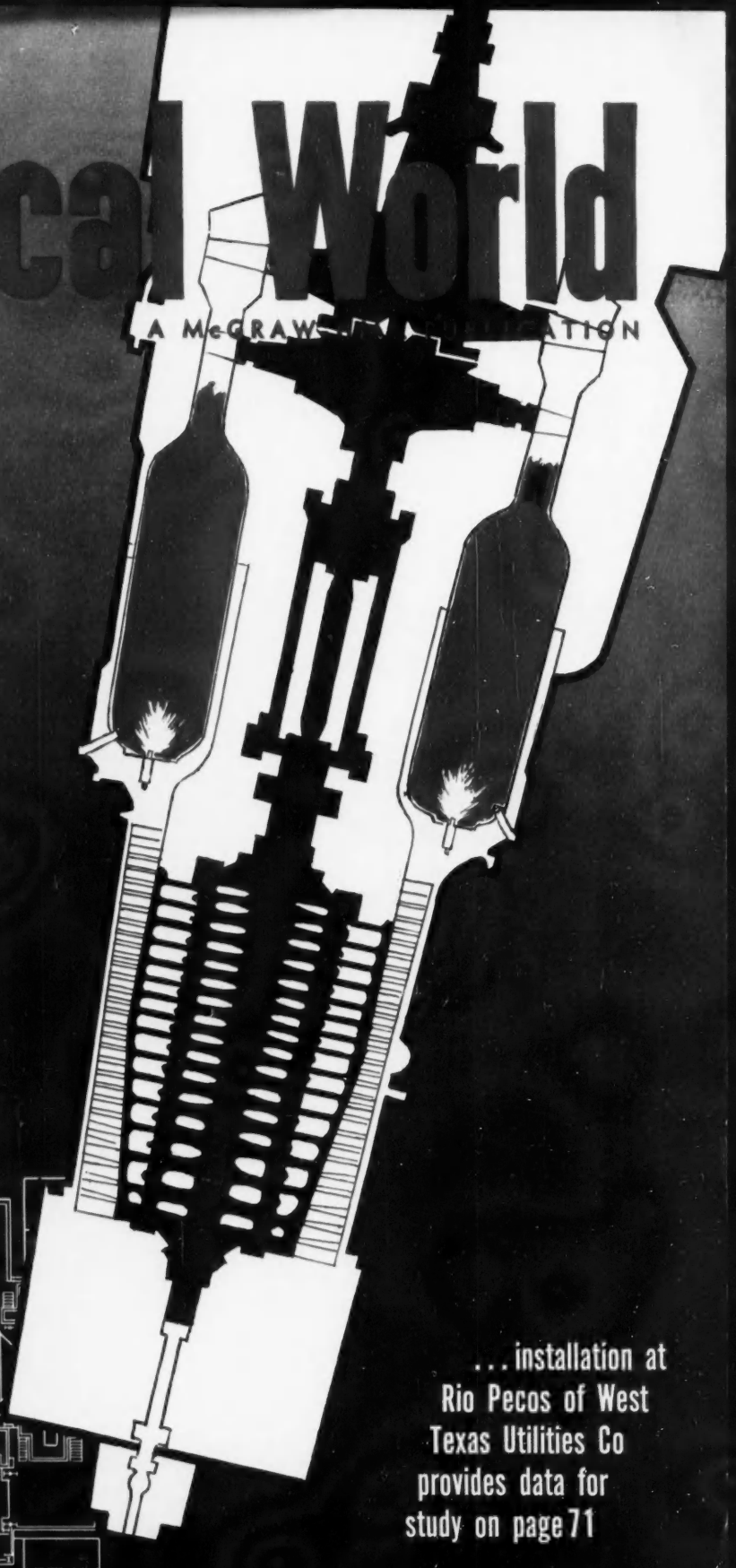

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stands out as
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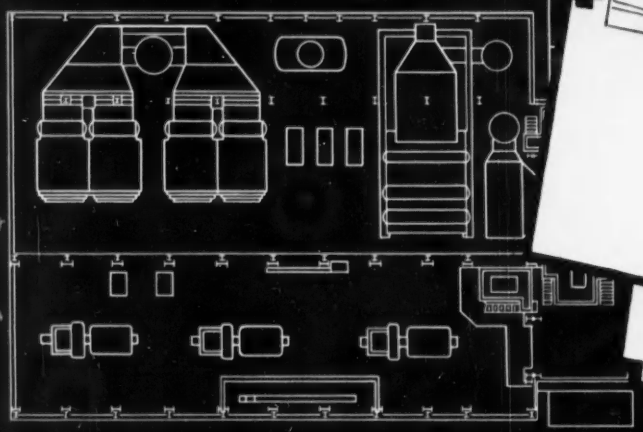
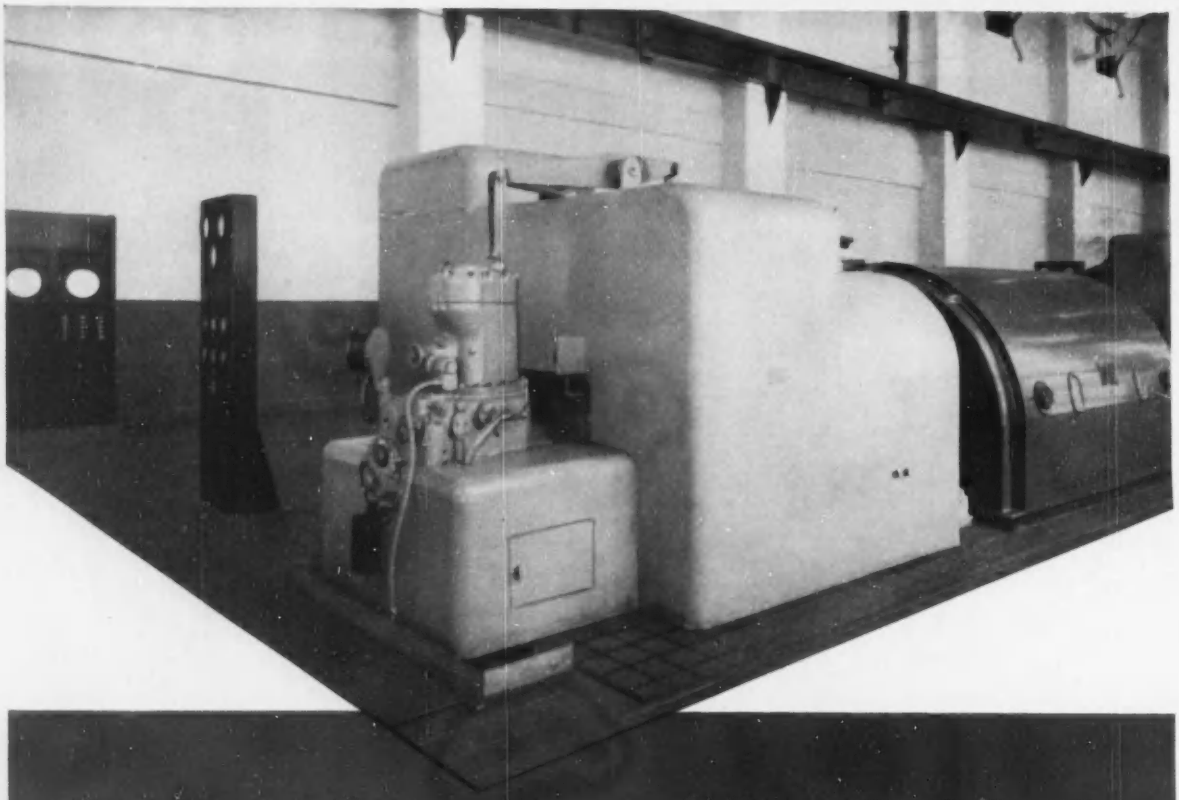


. . . installation at Rio Pecos of West Texas Utilities Co provides data for study on page 71



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FOR ALL TURBINES

Meet This Week's Writers

Edwin Vennard, author of the utilities' earnings article on page 64, is president of Middle West Service Co, Chicago consulting organization.

E. VENNARD

A native of New Orleans, La., Vennard graduated in 1924 from Tulane University with degrees in mechanical and electrical engineering. After working with General Electric Co, he became affiliated first with Gulf States Utilities Co and later with Southwestern G & E.

Rate Consultant . . . Before becoming president of Middle West Service, he was vice president of the service firm. He joined the organization in the middle 30's, serving as consultant on rates, new business, public and employee relations and advertising.

Advantages of American Standards Association's new power transformer standard are analyzed on page 67 by H. M. Jalonack of General Electric.

ASA Chairman . . . Jalonack presently is a member of the association's C57 Committee and chairman of its subcommittee on power and distribution transformers standardization.

H. M. JALONACK

Jalonack's affiliation with GE started in 1917 after graduating from Syracuse University with an electrical engineering degree. His efforts in transformer work won him the Charles Coffin Award in 1931. Jalonack in 1952 became manager of the marketing research and product planning distribution transformer department of GE's Transformer Division at Pittsfield, Mass.

Poet Laureate . . . In the field of poetry, his verses have earned him the sobriquet of "Poet Laureate of the Transformer Business."

Electrical World

Published for 80 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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Multi-conductor control cables have color-coded Okoprene over each conductor with an Okoprene sheath over-all.

Okolite-Okoprene cables can be furnished with interlocked bronze armor where troughs or trays are used.

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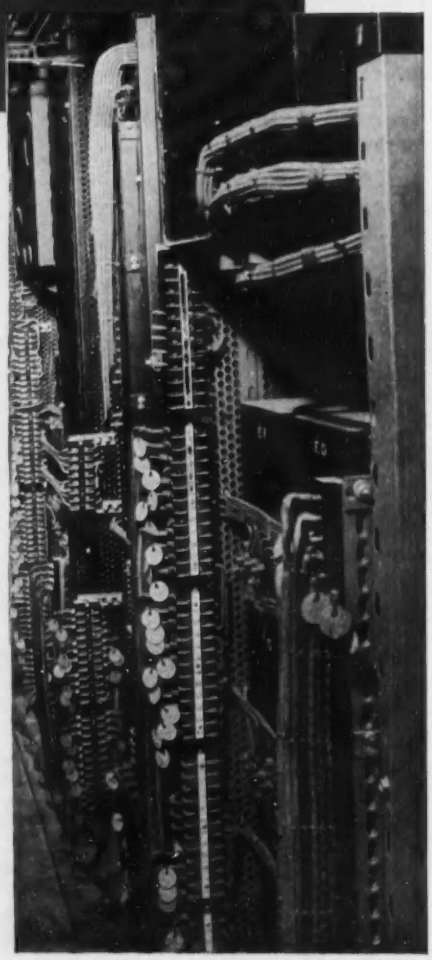

Control cable must be the most versatile of all types of cable. In its wide variety of uses, control cable may be called upon to operate under almost any kind of service condition.

Horizontal or vertical, indoors or out, above or underground, in wet, dry, hot or cold locations, exposed to oils, acids, chemicals, sunlight or any kind of weather—control cables must keep key circuits operating *around the clock.*

Okolite-Okoprene is one type of cable construction that fulfills every requirement for control cable. The principal reason for its usefulness as control cable is the unique combination of Okolite Insulation and Okoprene Sheath. These two combine the highest dielectric strength with the most impervious protective covering... resulting in an unequalled soundness both electrically and physically.

Yet there are many other features which contribute to Okolite-Okoprene's outstanding performance as control cable. *Bulletin EW-1056* gives full details and specifications, with a description of Okonite's famous strip insulating process, special Okoloy conductor coating, a-c and d-c super-voltage testing, and many more.

If your expanding electrical plans call for additional control circuits, make sure you use the one cable qualified to give you "round-the-clock" security: Okolite-Okoprene. Inquire today from The Okonite Company, Passaic, N. J.

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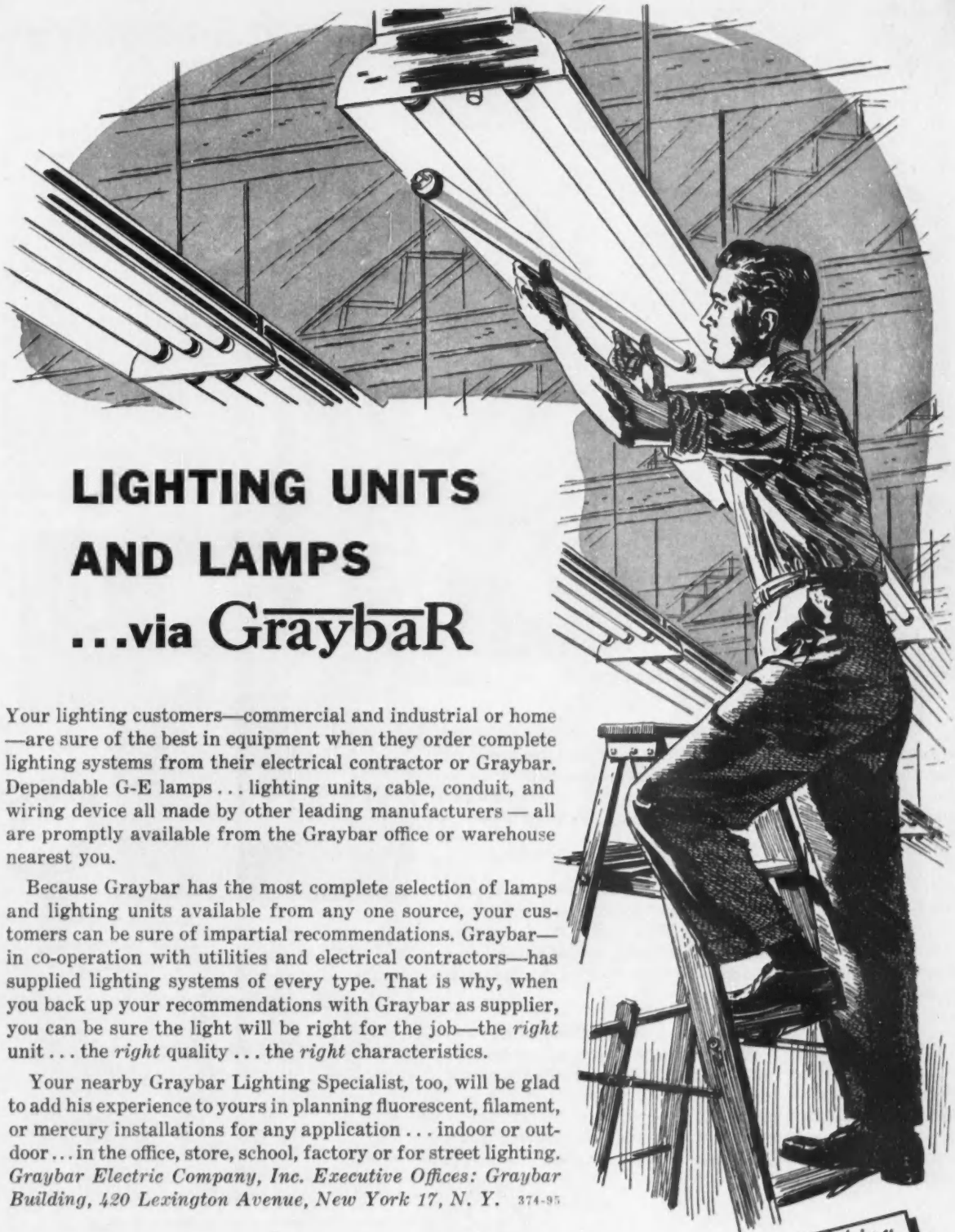
insulated wires and cables



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Your nearby Graybar Lighting Specialist, too, will be glad to add his experience to yours in planning fluorescent, filament, or mercury installations for any application . . . indoor or outdoor . . . in the office, store, school, factory or for street lighting. *Graybar Electric Company, Inc. Executive Offices: Graybar Building, 420 Lexington Avenue, New York 17, N. Y.* 374-95

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"with the G-R Vibration Meter we were able to prove conclusively..."

"Equiflex" shock mounts under investigation support the weighted-down wooden box on a standard vibration table. Table vibrates at any set frequency from 10 to 60 cycles per second. Type 761-A Vibration Meter reads directly the displacement, velocity, or acceleration of the shock-mounted box to determine operation under actual working conditions.

The Ucinite Company, in the course of developing a new vibration isolator which absorbs vibrations both vertically and horizontally, put their product through exhaustive tests. To assure performance and over-all quality . . . measurements were made with the General Radio Type 761-A Vibration Meter.

Ucinite development engineers have this to say:

"With the G-R Vibration Meter, we were able to prove conclusively that Ucinite's "Equiflex" mountings provide isolation of vibration over a wide frequency range. We found these mountings, with their all-metal supports, will withstand 15-G shocks without damage and will keep equipment captive up to 30 G's.

Where a large number of accurate vibration measurements must be made with a maximum degree of convenience, a precision instrument designed particularly for vibration measurements is definitely needed. The Vibration Meter filled our needs well. Because it measures directly the r-m-s displacement, velocity and acceleration, we were able to quickly and accurately ascertain the vibration efficiency of the "Equiflex" mountings during all stages of design."

Type 761-A
Vibration Meter $490
measures displacement, velocity, and acceleration of mechanical vibrations in machines, parts, and structures.

RANGE

Displacement—16 micro-inches to 30 inches, rms
Velocity—160 micro-inches per second to 300 inches per second, rms
Acceleration—0.16 inch per second per second to 3900 inches per second per second, rms

Write for the G-R SOUND AND VIBRATION BULLETIN which describes our complete line of sound and vibration meters and analyzing equipment.

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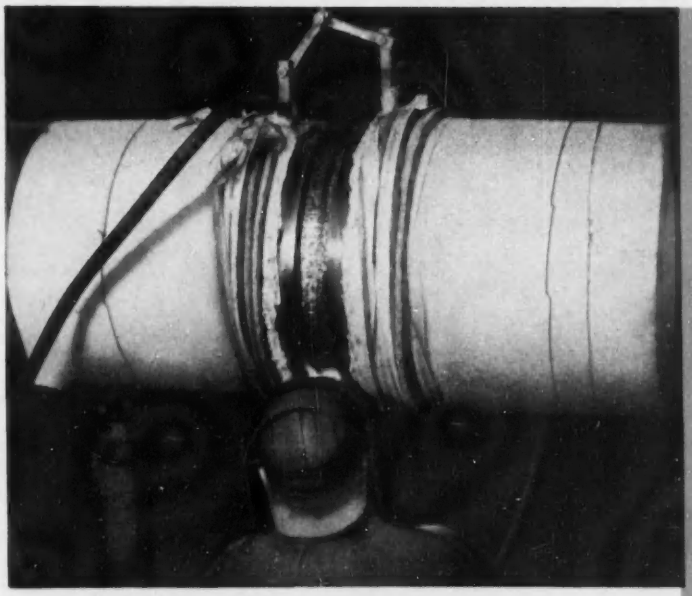
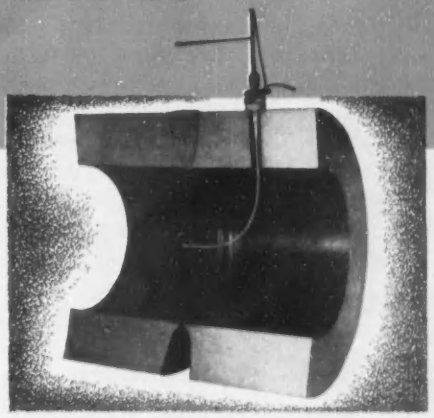


SHOP WELDING 4" WALL PIPE

for steam at 2050 PSI and 1050° F!



A test piece of 4" wall pipe cut apart to show the quality of the weld. Also illustrated is the method used to introduce a radium capsule into the center of a completed assembly for radiographic examination of the weld.

You can be confident of the piping fabricated in Grinnell shops, because Grinnell Research predetermines materials and methods, then checks results to insure that specifications are met exactly.

An example of the thoroughness of Grinnell Research is the preparatory work which was done to insure the performance of the piping shown above. This sub-assembly is being fabricated from 4" wall pipe forged from 2¼% chrome, 1% moly steel. To withstand the high pressure and temperature of this installation, Grinnell Research specified the fabricating and welding procedures to be used. This included the time and temperature cycles for preheating and stress relieving, and the correct type of electrodes.

Preliminary test welds on sample pipe were made. These were then cut apart and analyzed to check microstructure and strength of the weld, which had to have the same properties as the pipe itself.

Taking photomicrograph of specimen of a test weld.

During fabrication, the first inch of each weld was ground smooth and given a complete radiographic examination for possible flaws. Finally the completed weld was checked by radiographic examination.

It's intricate business . . . developing correct fabrication methods for new materials and services. It's one of the jobs for which Grinnell fabrication specialists are well qualified, because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel to handle any prefabrication requirement.

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Grinnell Company, Inc., Providence, Rhode Island • **Coast-to-Coast Network of Branch Warehouses and Distributors**

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The neat design of the modified Venturi throat, the precision-manufactured assemblies and the rigid, bolted construction all contribute to smoother air flow and permit the closest possible blade clearances. Such exactness results in exceptional fan efficiency.

You want outstanding cooling performance. You want to increase the efficiency of your power plant. Then find out all the reasons why Pritchard Heavy-Duty Cooling Towers do these jobs better. Contact your Pritchard representative listed in the classified section of the telephone directory or write direct to the address at right.

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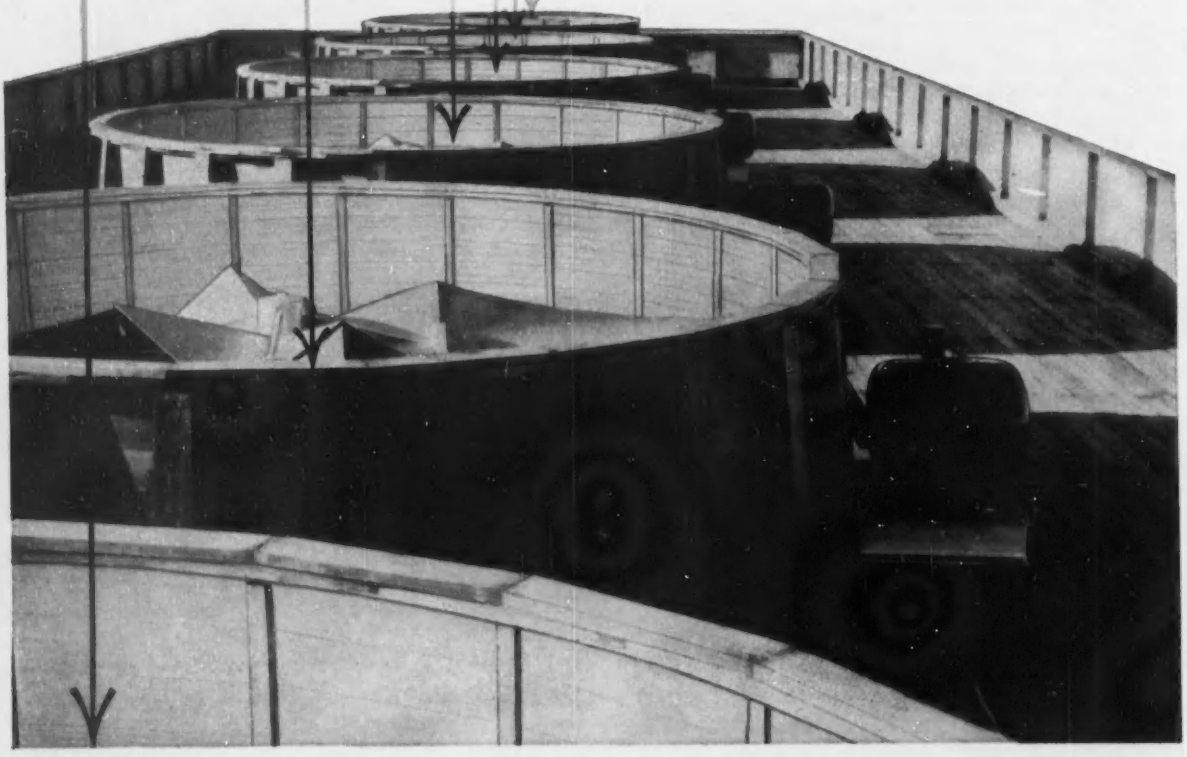

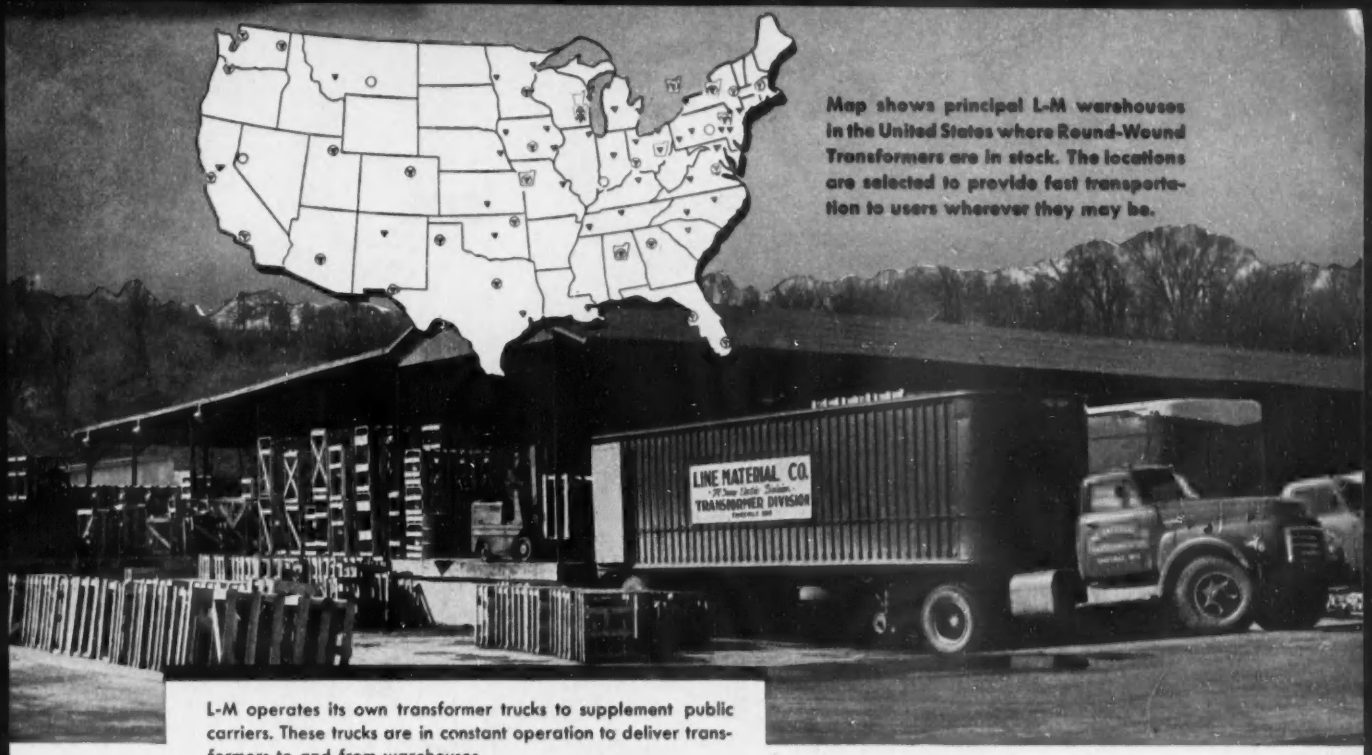

Map shows principal L-M warehouses in the United States where Round-Wound Transformers are in stock. The locations are selected to provide fast transportation to users wherever they may be.

L-M operates its own transformer trucks to supplement public carriers. These trucks are in constant operation to deliver transformers to and from warehouses.

Stocks in 45 Warehouses Assure Prompt Delivery of L-M Round-Wound Transformers

When you need an L-M Round-Wound Transformer fast, L-M can get it there. To take care of customer requirements, L-M years ago set up a system of strategically located warehouses. In recent years production has been substantially increased for the express purpose of augmenting these warehouse stocks. Today most sizes and ratings of L-M Round-Wounds are available in a warehouse near you.

This warehousing service has been designed especially as a "customer plus" service. Operations have been set up to speed the handling of orders. L-M has set up its own transformer truck fleet to provide additional flexibility and faster service in emergencies.

Crating has been designed both for the protection of the transformer and for the convenience of the user. Bases of the crates are designed for lift trucks. High grade heavy lumber is used to assure the greatest possible protection to transformers and bushings.

If you want outstanding transformers, and prompt delivery, ask the L-M Field Engineer about L-M Round-Wound Transformers. Or write for Bulletin DT1, to Line Material Company, Transformer Division, Zanesville, Ohio (a McGraw Electric Company Division).

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Large stocks in all warehouses are designed so they will meet the needs of each particular area. In addition, a system of stock reporting makes it possible to transfer additional transformers promptly should a shortage develop at any one warehouse. Master stocks at the factory are crated, ready for prompt shipment.

"Round-Wound" is a Line Material Company trademark

LINE MATERIAL *Transformers*

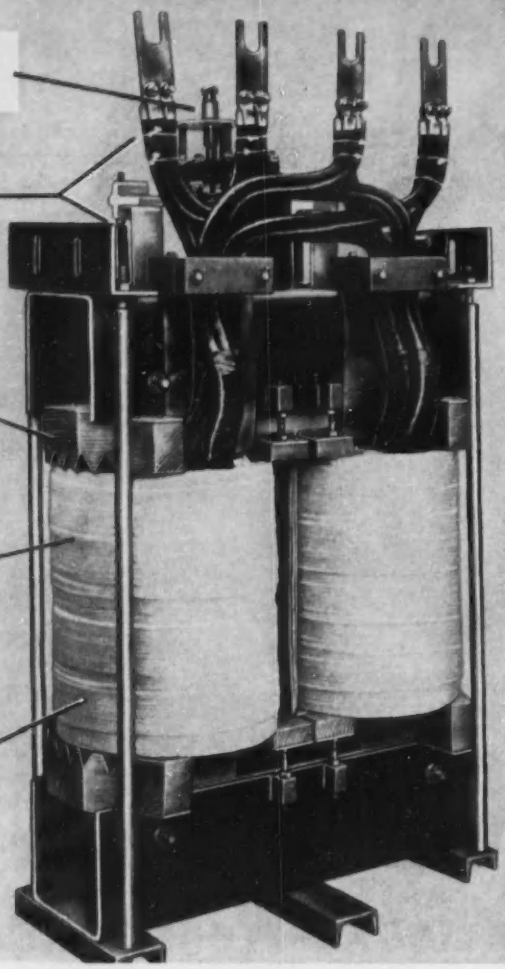
1 Long creepage distances on tap-changer.

2 Leads are carried well away from frame, and are protected with insulation barriers.

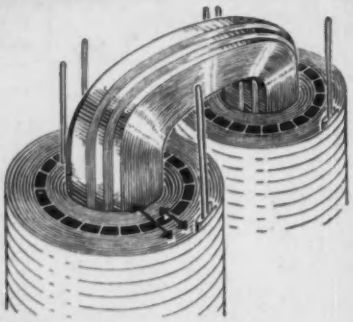
3 Strong oil-impregnated maple blocks assure ample distance between coils and grounded frame.

4 Round coils are not malleted into shape; there are no corners or sharp bends that might contribute to insulation failure.

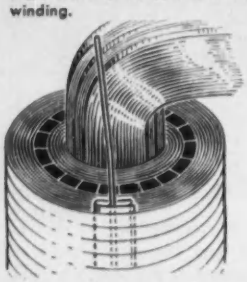
5 Core and coil assemblies are carefully processed to assure removal of moisture and air, then oil-impregnated under vacuum with ORTO.



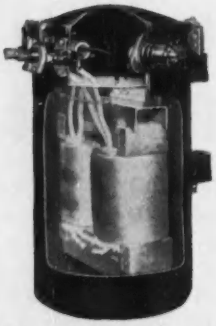
Round-Wound core-coil assembly. This construction offers the designer a number of opportunities to get maximum effectiveness from insulation materials, and to secure the greatest possible leakage distances. The illustration shows points at which we take special advantage of the design to coordinate insulation puncture resistance and creepage distance to get highest possible impulse level.



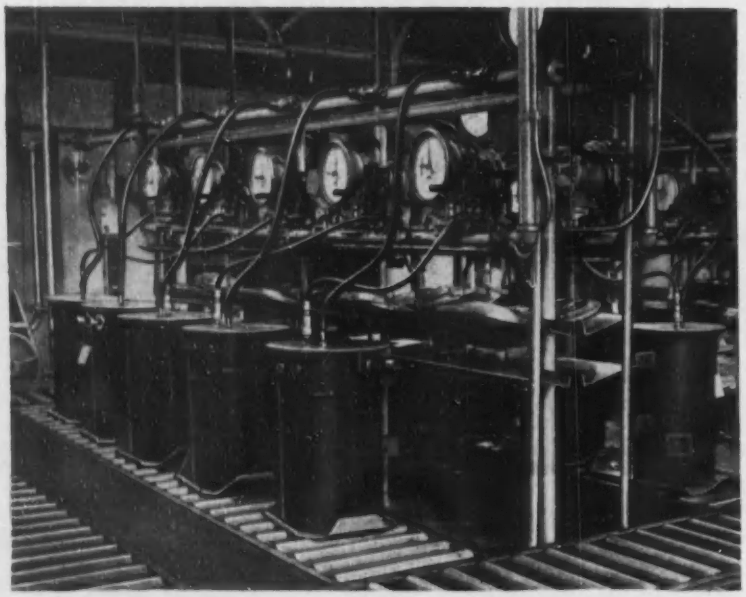
The low-voltage winding and leads, easiest to insulate, are wound next to the core. High-voltage line leads are located on the outside of the coil. Note that long creepage distances are obtained from these leads to the core and low-voltage winding.



Folded pads of insulating paper give special protection to leads where they emerge from the coils.



There is ample distance between high-voltage leads and tank wall. Oil level is well above core and coil assembly live parts.

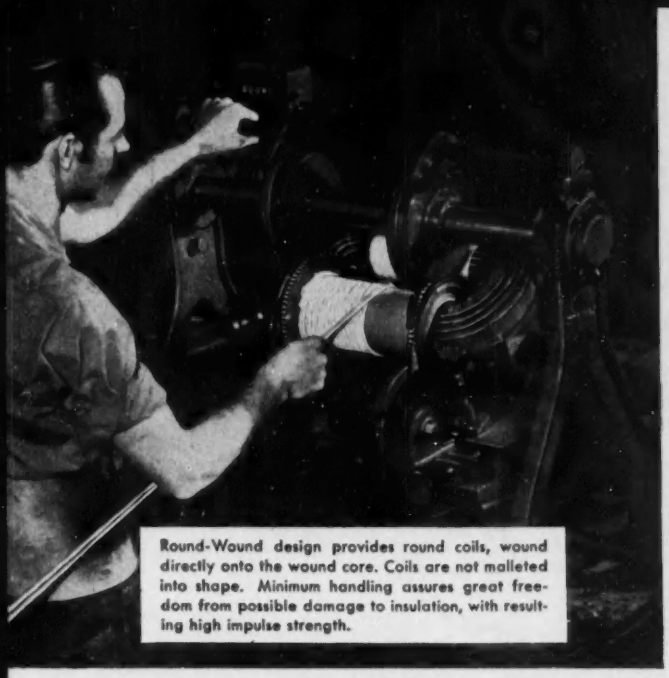


After controlled removal of moisture from the core and coil assembly, thorough oil penetration and complete absence of corona-producing voids are assured by vacuum oil-impregnation with dry, de-aerated ORTO, L-M's oxidation-resistant transformer oil, inhibited for longer life.

Lightning frequency map. Figures show average thunderstorm days per year. L-M Round-Wound transformers prove their high impulse strength in such areas

Get This New Bulletin

High impulse strength is only one of the many advantages of L-M Round-Wound transformers. We'd like to tell you some of the others. Ask the L-M Field Engineer for a copy of the new Bulletin DT1; or write Line Material Company, Transformer Division, Zanesville, Ohio (a McGraw Electric Company Division).



Round-Wound design provides round coils, wound directly onto the wound core. Coils are not malleted into shape. Minimum handling assures great freedom from possible damage to insulation, with resulting high impulse strength.

Oscillographic observations of impulse test. Destructive testing of units incorporating new materials, component parts, or design and processing changes assures effectiveness of design as well as manufacturing quality

High Impulse Strength Inherent In L-M Round-Wound Transformer Design

How the transformer designer takes advantage of many related factors contributing to reduced failures from either lightning or switching surges.

by **ROBERT P. THOMPSON**
Assistant Chief Engineer
Transformer Division
Line Material Company

Uniformly high impulse strength is an important factor in the excellent service record of L-M Round-Wound* transformers. High impulse strength, or level, is the result of a number of factors, each of which is important in arriving at an over-all good result.

Requirements For High Impulse Level

Lightning damage occurs when a lightning surge flashes over inside the transformer, and is followed by a 60-cycle current arc. Often extensive permanent damage is caused by the follow current.

Severe switching surges can also cause unusual and sometimes destructive stresses in transformer insulation.

Any weak spot in insulation is an invitation to trouble. Damage to insulation during manufacture, even though slight, can prove to be serious.

Insulation puncture resistance and creepage distances must be correlated for optimum insulation performance. Contaminants, such as moisture, must be strictly controlled. Thus, no single factor can be overlooked.

Round-Wounds Easy to Insulate

Fortunately, the Round-Wound design inherently allows insulating materials to be used with maximum effectiveness.

Since the design provides for round coils wound directly onto an already annealed, uncut core, handling is reduced, thus minimizing the possibility of resultant damage.

The coils, being round, are not malleted into shape during winding; nor are there any corners of short radius in the windings which could contribute to insulation failure. The result is a coil whose insulation has in no way been impaired.

L-M engineers take full advantage of the physical characteristics of the core-type design in coordinating puncture strength and creepage distance. Locations where higher voltage stresses occur, as where leads emerge, are treated with special consideration.

Round-Wound core and coil assemblies are carefully processed to assure removal of moisture and air and then are thoroughly vacuum oil-impregnated with clean, dry ORTO®, L-M's oxidation-resistant transformer oil.

The result of this precise care is uniformly high dielectric strength under both surge and 60-cycle stresses.

Customers' Experiences Confirm Round-Wounds' High Impulse Level

With the majority of users, the high impulse strength of L-M's Round-Wound transformer is generally taken for granted. But for some there exist conditions more severe than the day-to-day opposition to switching surges. From operators located in areas with a high incidence of thunderstorms comes gratifying proof of the uniformly high impulse level of the Round-Wound transformer.

Ray W. Villyard, Manager of the San Luis Valley Rural Electric Cooperative, Monte Vista, Colorado, writes:

> **"Our area averages over 175 thunderstorm days per year. Both our laboratory tests and our field experience indicate an exceptionally high impulse level for Round-Wound transformers. Our total failure rate for Round-Wounds is less than ¼ of 1% a year. Therefore, we have increased our purchase of Round-Wound each year."**

Another executive whose company operates in a high lightning frequency area writes:

> **"In our territory, extending from the plains at 3500 feet to points well over 10,000 feet in the heart of the Rocky Mountains, we have hundreds of thunderstorms each year. We have found that Round-Wound transformers stand the gaff. Our failures have been so few that we are buying more L-M Round-Wounds."**

*"Round-Wound" is a Line Material Company trademark.

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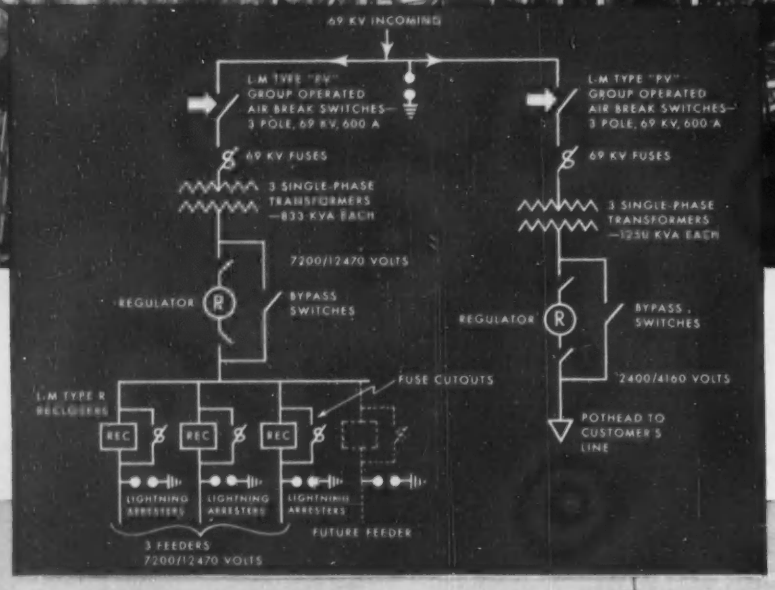
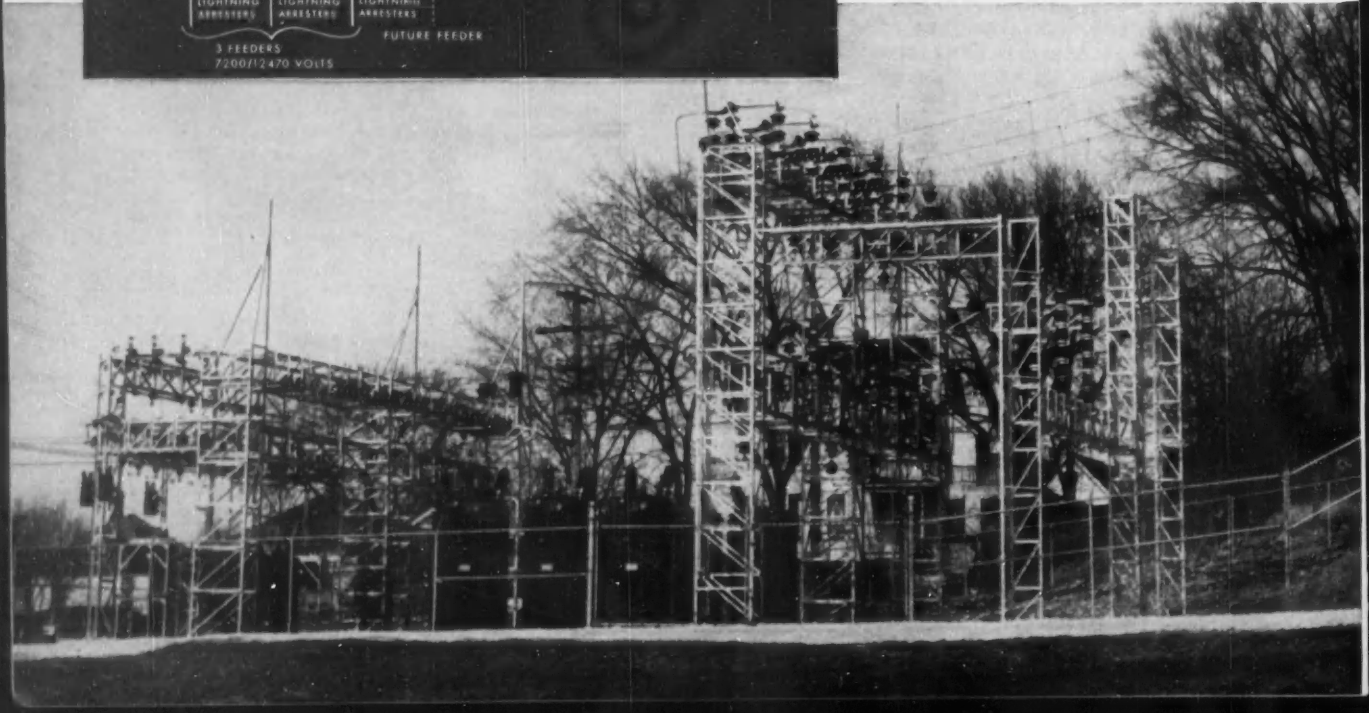
LINE MATERIAL Transformers

Two 3-pole Type PV switches being installed at a substation in the middle west, along with other L-M equipment and apparatus. L-M also supplied its fabricated structural steel, which simplified construction of the station.

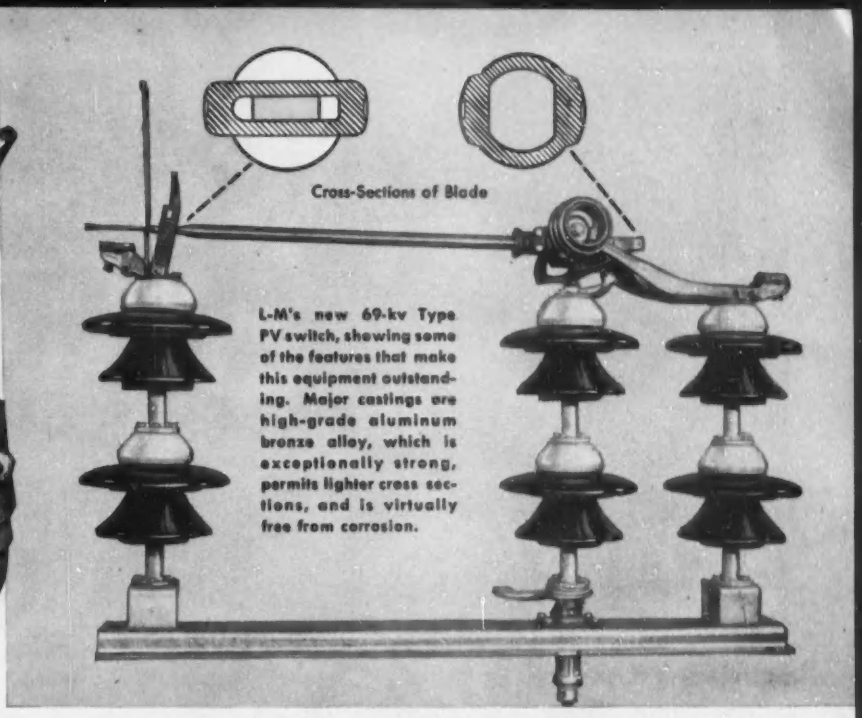


One-line diagram of the substation shown above. Incoming 69-kv power divides into two feeders, one 7200/12470 volts, the other 2400/4160 volts. Each section is provided with a 69-kv 600-ampere L-M Type PV 3-pole switch mounted on the structure.

Completed substation, showing L-M's type PV switch installation.



Jaw contact assembly. Silver inserts (1) on contact side are backed by copper blocks (2) on the back to dissipate heat. Springs (3) held by tie bar maintain uniform pressure. Easily adjusted in field with simple gauge specifically designed for this purpose. Contact shoes easily replaced; cannot be misaligned. Terminal connector at base permits tight grip on conductors from 3/22" to 1 3/16" by turning or reversing the clamp pad (4).



L-M's new 69-kv Type PV switch, showing some of the features that make this equipment outstanding. Major castings are high-grade aluminum bronze alloy, which is exceptionally strong, permits lighter cross sections, and is virtually free from corrosion.

Nothing—But Nothing—Stops The Operation of L-M's New Type "PV" Air Break Switches

Powerful lever advantage assures operation to open or closed position regardless of ice, corrosion, or long periods of non-operation.

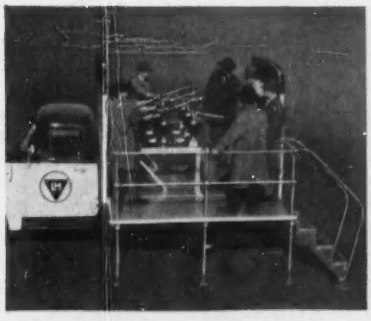
by **R. D. CLEAVES**
Manager
Protective and Switching Equipment
Line Material Company

In designing our line of rotating insulator switches, one of our engineers' principal concerns was to build a switch that would operate under almost any conceivable conditions. In addition it must meet all of the other requirements for a good switch—ease of operation, convenience and simplicity of installation, high current carrying capacity, high contact pressure without undue wear.

We believe that we have amply met these requirements in our PV switch line. We also feel that we have added some features not heretofore available on the market.

Some of these features are: silver-to-silver high pressure contacts; new contact design, with contact pressure easily adjusted in the field; ball bearings lubricated for life and sealed with silicone cord rings; only 6 current interchange points in the entire switch; ingeniously designed terminals permitting tight clamping of conductors from 3/22" to 1 3/16", or connection to bus bar or lugs.

These switches are for both pole and structure mounting in horizontal, vertical, or inverted position. Interphase assembly may be direct or indirect connected; it permits operation within a wide range of misalignment of mounting. Ratings from 7.5 through 69 kv in 400 and 600 amperes continuous current carrying capacity. Available with or without horn gaps, from one to six-pole units.



Have you seen L-M's new switching equipment demonstration truck? Ask the L-M Field Engineer to schedule a demonstration for your group.

For complete information on L-M Type PV Switches ask the Field Engineer for a copy of Bulletin PSE1, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

New Switch Design Assures Positive Operation

Drawings show blade rotation and rise between the jaw contacts.

1. Normal closed position—blade between contacts and locked in position by the action of the link and crank assembly.

2. Start of opening motion. The blade twists and actually lowers itself 1 degree before starting to rise. Here 20 degrees rotation of the crank twists the blade 26 degrees to break any ice or corrosion.

3. The blade is now starting to rise. It has rotated 40 degrees with only a 3 degree rise. Also note how blade rotation has moved the silver inserts away from the silver in the contact shoes, minimizing wear.

4. With approximately 37 degrees crank rotation, the blade has been rotated a full 48 degrees, but has risen only 6 degrees. Up to now, practically all of the force has been applied to blade rotation.

5. Blade has risen 9 degrees with a 56 degree blade rotation. On closing the switch, the reverse motion provides the most effective possible ice-breaking action if the switch should be iced open.

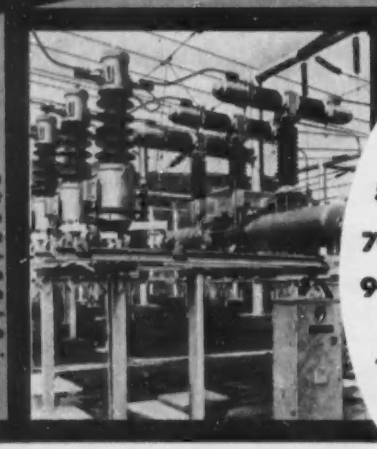
LINE MATERIAL
Power Switching Equipment

"CART WHEEL" or that "GREEN STUFF"

BROWN BOVERI

AIR BLAST BREAKERS

Though the silver dollar and a dollar bill are of equal monetary value, the bulkiness of the "cartwheel" explains the preference for paper currency. So, too, is the trend in circuit breakers toward the use of *air* rather than oil. The problem in breaker design is to get the interrupting medium between the contacts as quickly and as efficiently as possible. The use of a low-inertia medium (such as AIR in contrast to oil) controlled by a few, light, moving parts provides a design which, in Brown Boveri Air Blast Breakers, makes these advantages possible:



69 kv Brown Boveri Air Blast Breaker. A large number of these and similar breakers for voltages up to 230 kv are on order and in service in both the U.S.A. and Canada.

1—High Interrupting Capacity

2—High Current Carrying Capacity

3—High Speed and Thorough Reliability

4—Rapid Reclosing

5—Positive Interruption under All Conditions

6—Safety

7—Low Installation Cost

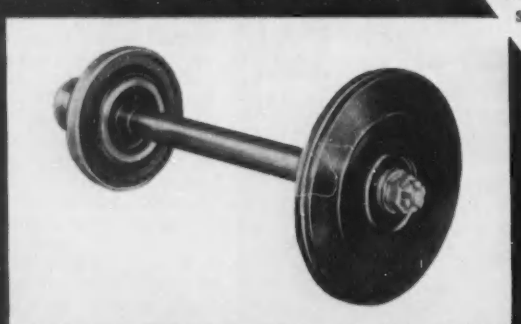
8—Rapid and Easy Inspection

9—Minimum Maintenance

10—Low Initial Cost

11—Proven Dependability

The air flow in a Brown Boveri Air Blast Breaker is controlled by a blast valve, shown at the left. There are no mechanical linkages to exert sideway (lateral) stresses which might produce undesirable friction. The exceedingly simple design and light weight of the blast valve — one of similar engineering accomplishments found only in a Brown Boveri Air Blast Breaker — account for its inherent high speed.



You can EXPECT MORE . . . and GET MORE . . . from a Brown Boveri Outdoor or Indoor Air Blast Breaker. Write for complete data TODAY!

BROWN BOVERI

BROWN BOVERI CORPORATION

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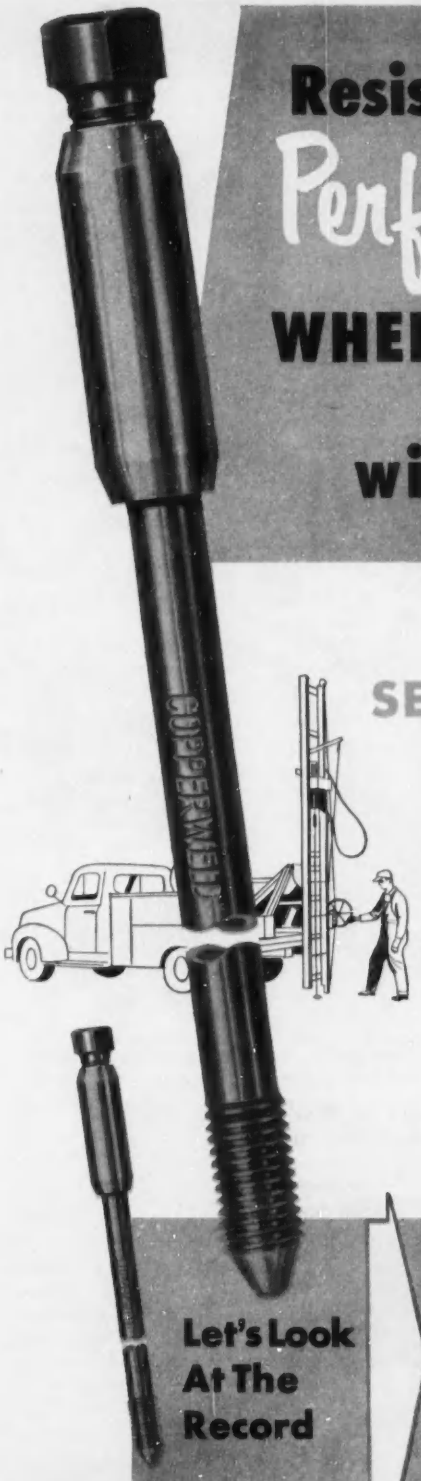
Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Butte, Mont. • Chicago, Ill. • Cleveland, O. • Denver, Colo. Detroit, Mich. • High Point, N.C. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Lewiston, Me. • Los Angeles, Cal. Minneapolis, Minn. • New Orleans, La. • New York, N. Y. • Portland, Ore. • San Francisco, Cal. • Seattle, Wash. • Tucson, Ariz.

Resistance Goes Down . . .
Performance GOES UP
WHEN YOU DEEP GROUND
with JOSLYN



Copperweld
SECTIONAL GROUND RODS

To get low-cost, dependable grounding protection, leading engineers are using Copperweld* Sectional Ground Rods driven deep to reach the strata of better conducting soils.

Companies employing deep grounding have reduced interruptions on their overhead systems. They report fewer transformer failures and blown fuses, as well as less burnouts of meters and other equipment.

With Copperweld Sectional Ground Rods, deep grounding is simple, efficient and economical. And, only Copperweld Rods have a stiff steel core for easy driving, with a MOLTEN-WELDED copper exterior providing conductivity and protection against corrosion.

Remember, top performance and low resistance go hand-in-hand. To obtain low resistance economically, drive deep with Copperweld Sectional Ground Rods.

Let's Look At The Record

Here are a few typical results of tests, made throughout the country, showing how good grounds are obtained by deep grounding with Copperweld Sectional Ground Rods.

Location	Resistance Of First 8' Section—Ohms	Resistance Of Deep Ground—Ohms	Depth Of Deep Ground—Feet
Springfield, Mass.	3000	20	48
Petersburg, Va.	400	4	62
Tampa, Fla.	100	6	22
Youngstown, Ohio	35	6	40
Jackson, Mich.	250	6	30
Alton, Ill.	210	6	72
Brainerd, Minn.	500	5	33
New Orleans, La.	200	5	64
Corpus Christi, Tex.	400	3	24

*Trade Mark

JOSLYN

JOSLYN MFG. and SUPPLY CO.
Executive Offices: 20 N. Wacker Dr., Chicago 6, Ill.

3-Direction Control for Cranes is Our Specialty

For more than half a century, EC&M has led in the development of sturdy, highly efficient electrical equipment for cranes.

Designed into this equipment is that extra margin of safety and quality which insures uninterrupted service to the user . . . which also includes features helpful to maintenance men and operators, aiding them in their daily tasks.

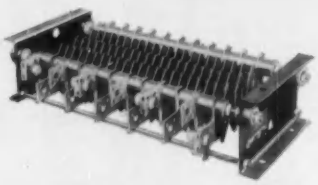
Users recognize the symbol, (EC&M) as a standard of value and specify this equipment whenever new cranes are purchased or when revamping existing installations. These users know that control, only a small part of the initial cost, is a vital part of every crane.

It pays to standardize on EC&M Control for cranes.

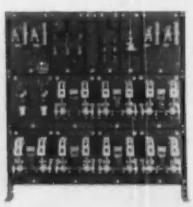
Long-Life Brakes for cranes operated by a-c or d-c power . . . give high speed performance with low upkeep.

Youngstown Safety Limit Stops protect against overhoisting accidents . . . a positive check against human errors.

Cam-Type Master Switches have narrow width and short throw . . . less fatigue for the operator.



Tab-Weld Plate Resistors feature spot-welding that provides a continuous path and keeps resistance value constant.



Reversing - Plugging Control for bridge and trolley motions . . . automatically controlled acceleration and only one adjustable relay for plugging.

Manual - Magnetic Disconnect Switches operate with ease . . . are arranged to control crane lights also.

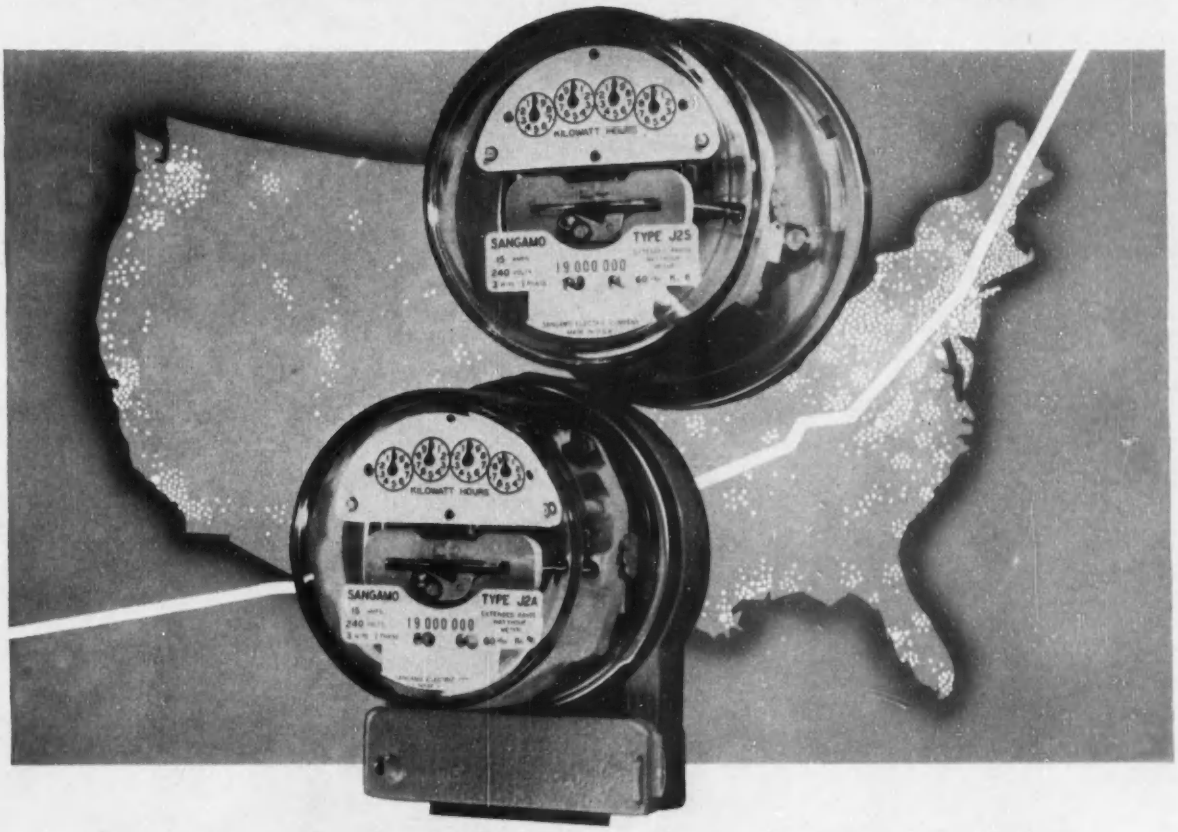
WRITE TODAY FOR BOOKLET 921

FOR A COMPLETE LINE OF CRANE CONTROL SPECIFY EC&M

THE ELECTRIC CONTROLLER & MFG. CO.

2698 EAST 79th ST. • CLEVELAND 4, OHIO

it's EVOLUTIONARY! it's NEW! the Sangamo Type J2



...to measure the Nation's growing power load

The nation's growing residential power load has led to a wiring capacity crisis that the electrical industry is meeting with a National Adequate Wiring program.

Adequate *measurement* of these heavier loads of the future will require a watthour meter with straight line accuracy up to 100 amperes—a meter capable of handling all foreseeable increases in average residential consumption. That's why Sangamo has developed the J2, a meter with reserve capacity to meet any contingency of future load growth.

The new Sangamo Type J2, with its extended range, will meet all requirements of accurate measurement for both today and the future.

The J2 is not a *revolutionary* new meter, but an *evolutionary* development from the time-proven Sangamo Type J. It retains many features that contributed to the proven electrical and mechanical stability of the Type J. Added improvements all contribute to better and longer performance over its extended operating range.

Get the facts . . . mail the coupon below for your copy of "Protect Your Investment in New Meters." It's just off the press, and gives the complete story of the evolution of the Sangamo Type J2 . . . the Meter with reserve capacity for growing loads.

SANGAMO

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

JM54-4

SANGAMO ELECTRIC COMPANY, SPRINGFIELD, ILLINOIS

Send my copy of "Protect Your Investment in New Meters"

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TITLE_____

COMPANY_____

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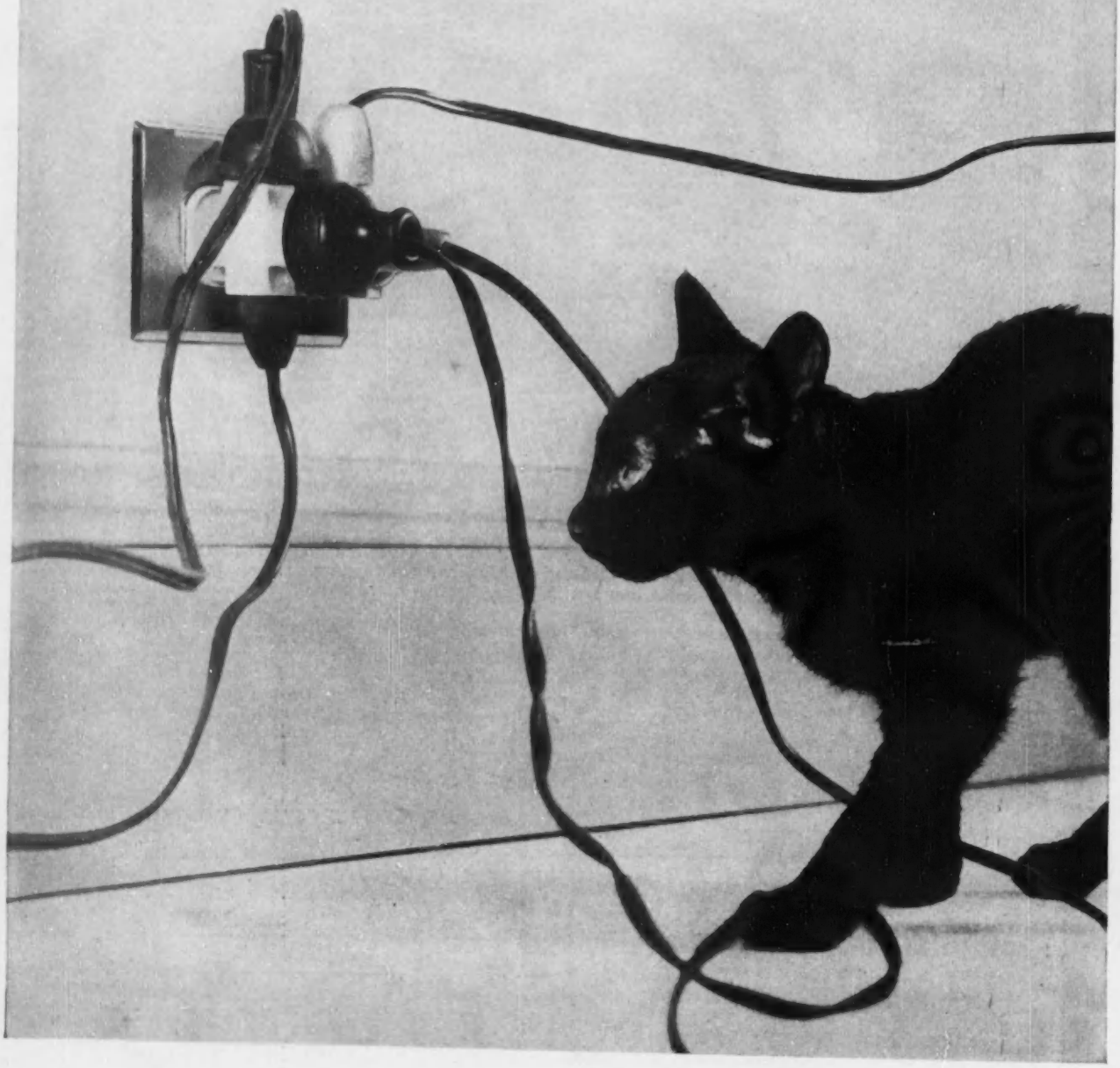
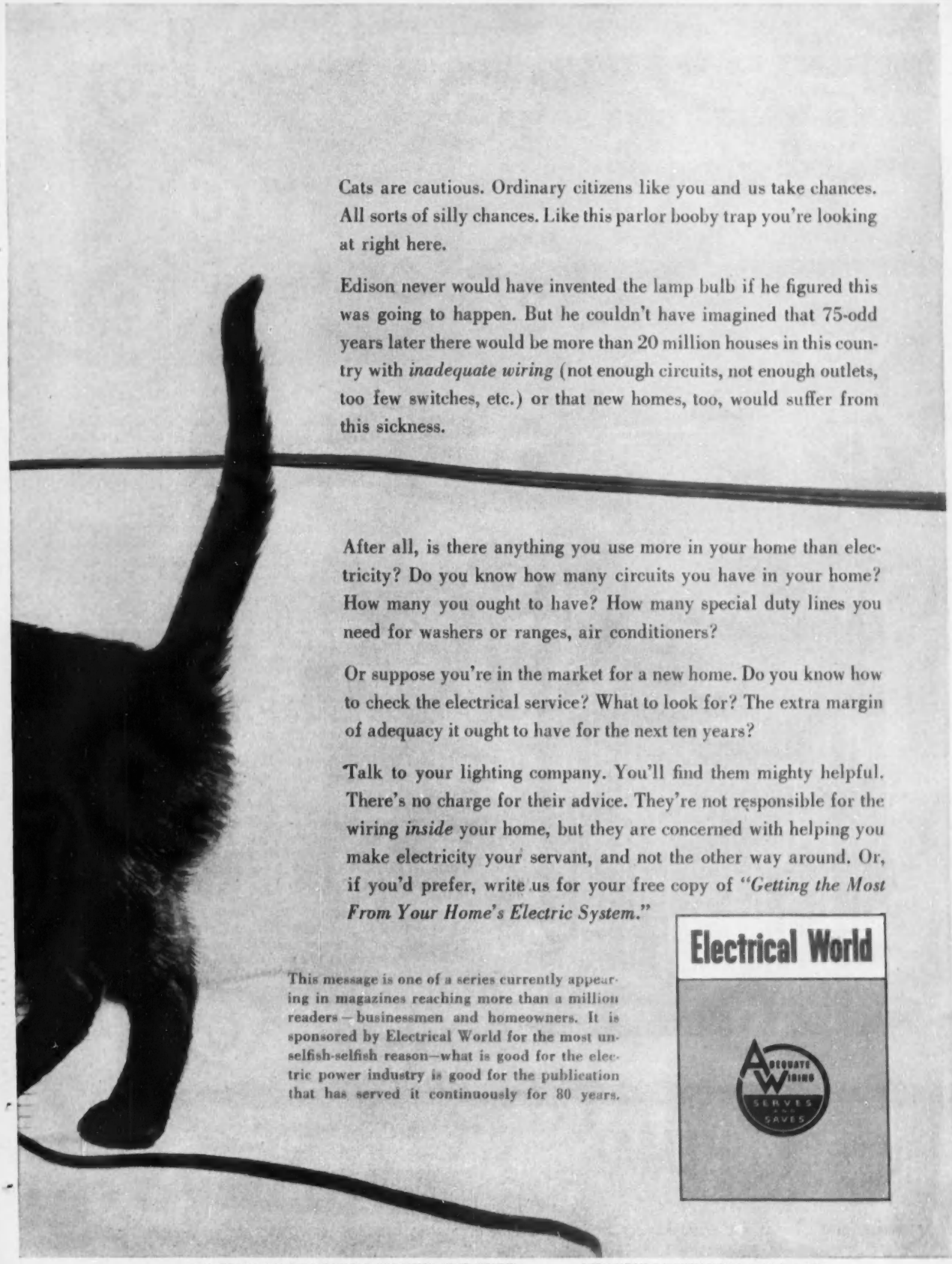
Why cats have 9 lives





Cats are cautious. Ordinary citizens like you and us take chances. All sorts of silly chances. Like this parlor booby trap you're looking at right here.

Edison never would have invented the lamp bulb if he figured this was going to happen. But he couldn't have imagined that 75-odd years later there would be more than 20 million houses in this country with *inadequate wiring* (not enough circuits, not enough outlets, too few switches, etc.) or that new homes, too, would suffer from this sickness.

After all, is there anything you use more in your home than electricity? Do you know how many circuits you have in your home? How many you ought to have? How many special duty lines you need for washers or ranges, air conditioners?

Or suppose you're in the market for a new home. Do you know how to check the electrical service? What to look for? The extra margin of adequacy it ought to have for the next ten years?

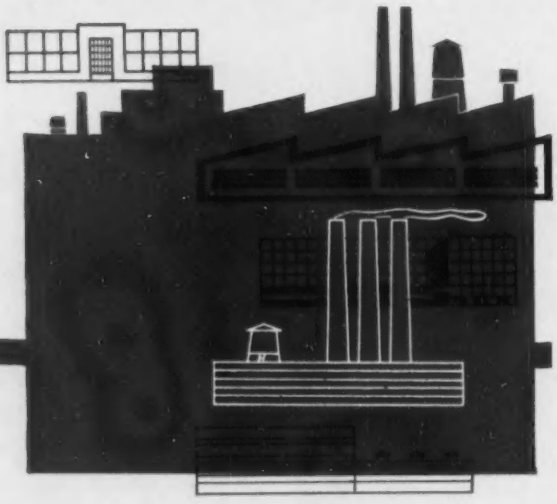
Talk to your lighting company. You'll find them mighty helpful. There's no charge for their advice. They're not responsible for the wiring *inside* your home, but they are concerned with helping you make electricity your servant, and not the other way around. Or, if you'd prefer, write us for your free copy of *"Getting the Most From Your Home's Electric System."*

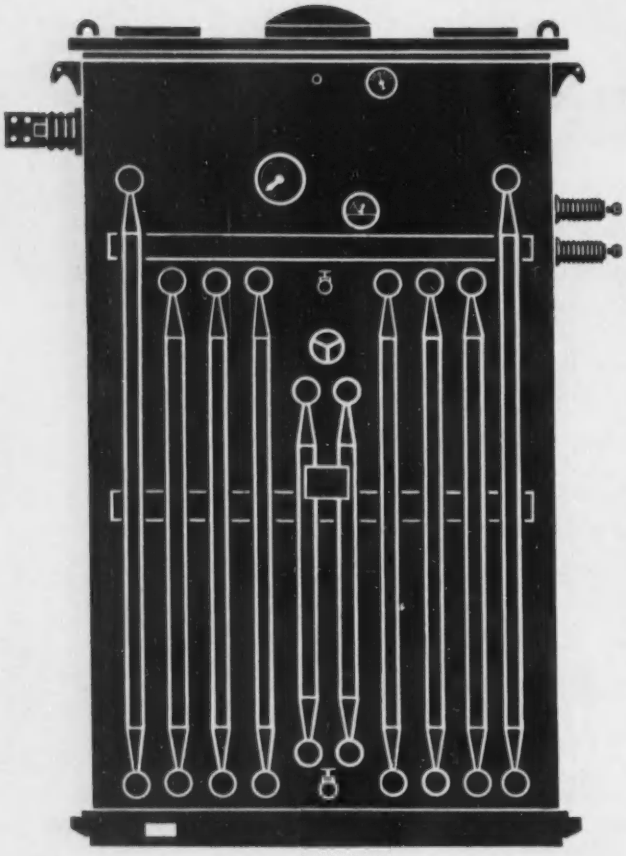
This message is one of a series currently appearing in magazines reaching more than a million readers—businessmen and homeowners. It is sponsored by Electrical World for the most unselfish-selfish reason—what is good for the electric power industry is good for the publication that has served it continuously for 80 years.

Electrical World

ADEQUATE WIRING SERVES AND SAVES

KUHLMAN *SAF-T-KUHL* TRANSFORMERS GIVE SAFER, LOWER-COST PERFORMANCE





Kuhlman Saf-T-Kuhl Transformers are filled with a patented synthetic cooling compound that is equal or superior to oil in di-electric strength, fluidity and thermal capacity. Yet the coolant is inert, non-explosive, non-inflammable and it will not sludge. The advantages of any unit employing such a coolant are well known.

- Saf-T-Kuhl Transformers can be installed anywhere in the plant without the use of expensive fireproof vaults.
- Voltage regulation can be improved and energy losses reduced by installing Saf-T-Kuhl Transformers near load centers and the expense of running long and large copper conductors can be eliminated.
- Floor space can be utilized exclusively for production by installing Saf-T-Kuhl Transformers above or below floor level.
- Maintenance costs are lower because the coolant does not require filtering or reconditioning.
- Insurance rates are lower in most states because Saf-T-Kuhl Transformers are absolutely safe and fireproof.

Saf-T-Kuhl Transformers are especially engineered to meet the requirements of heavy duty industrial service. The entire insulation structure is coordinated with the basic impulse level. Assemblies are thoroughly dried, and the coolant is introduced under vacuum to prevent entrapment of air and insure high insulation strength. Large ducts permit free circulation of the coolant to eliminate the danger of hot spots. Tanks are completely sealed. Cover and bushing gaskets are made from a special cork and synthetic rubber compound that gives exceptionally long life.

Kuhlman Saf-T-Kuhl Transformers are produced in a wide variety of single and three phase ratings. For complete information, write today for Bulletin CS-501. Kuhlman also manufactures, Power, Distribution, Dry Type, Subway, CSP and Series Street Lighting Transformers. Ask for bulletins on these units as well.

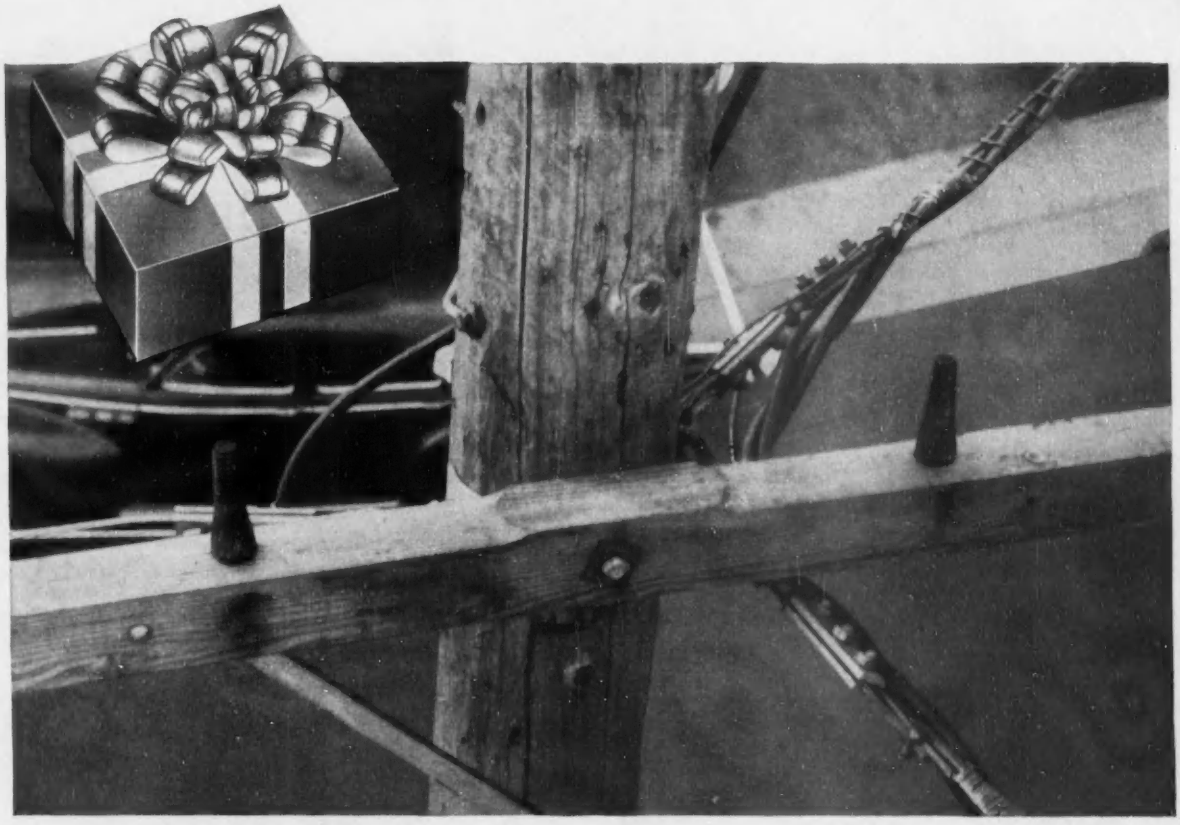
154-T

KUHLMAN

KUHLMAN ELECTRIC COMPANY, BAY CITY, MICHIGAN • Southern Division, CRYSTAL SPRINGS, MISSISSIPPI

EXPORT REPRESENTATIVE: INTERNATIONAL STANDARD ELECTRIC CORP., 15TH FLOOR, 50 CHURCH STREET, N. Y. 7, N. Y. CABLE ADDRESS: MICROPHONE, N. Y.

SIXTY YEARS OF PROGRESS IN THE ELECTRICAL INDUSTRY



Here's a Modern Aerial Cable Package

When you use Simplex Self-Supporting Aerial Cable, you get a neat, modern package like this. There are no fabrics or braids to fray or rot, and nothing to festoon and make a poor appearance.

Simplex Self-Supporting Cable consists of one or more Anhydrex-insulated, neoprene-jacketed conductors bound to a copperweld messenger with flat copper tape spiraled over the assembly.

You save on installation too. You simply pull the cable into position, tighten the pre-assembled messenger to the proper tension, clamp the messenger to a pole, and that's all.

Chafing tree limbs will not bother ANHYDREX Cables because of their specially compounded neoprene jackets which resist sunlight, heat, oil, chemicals, abrasion, fungus, and weather influences. Catalog No. 1006, ready in about one month, has more details. Send for it today.

Simplex – ANHYDREX
Self-Supporting Aerial Cable

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

Major Developments

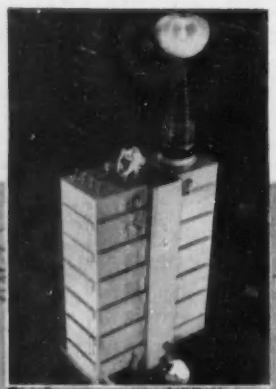
Transformers for TODAY and TOMORROW

TO MEET TODAY'S NEEDS, Allis-Chalmers is building transformers with capacities up to 220,000 kva and others for 345-kv transmission.

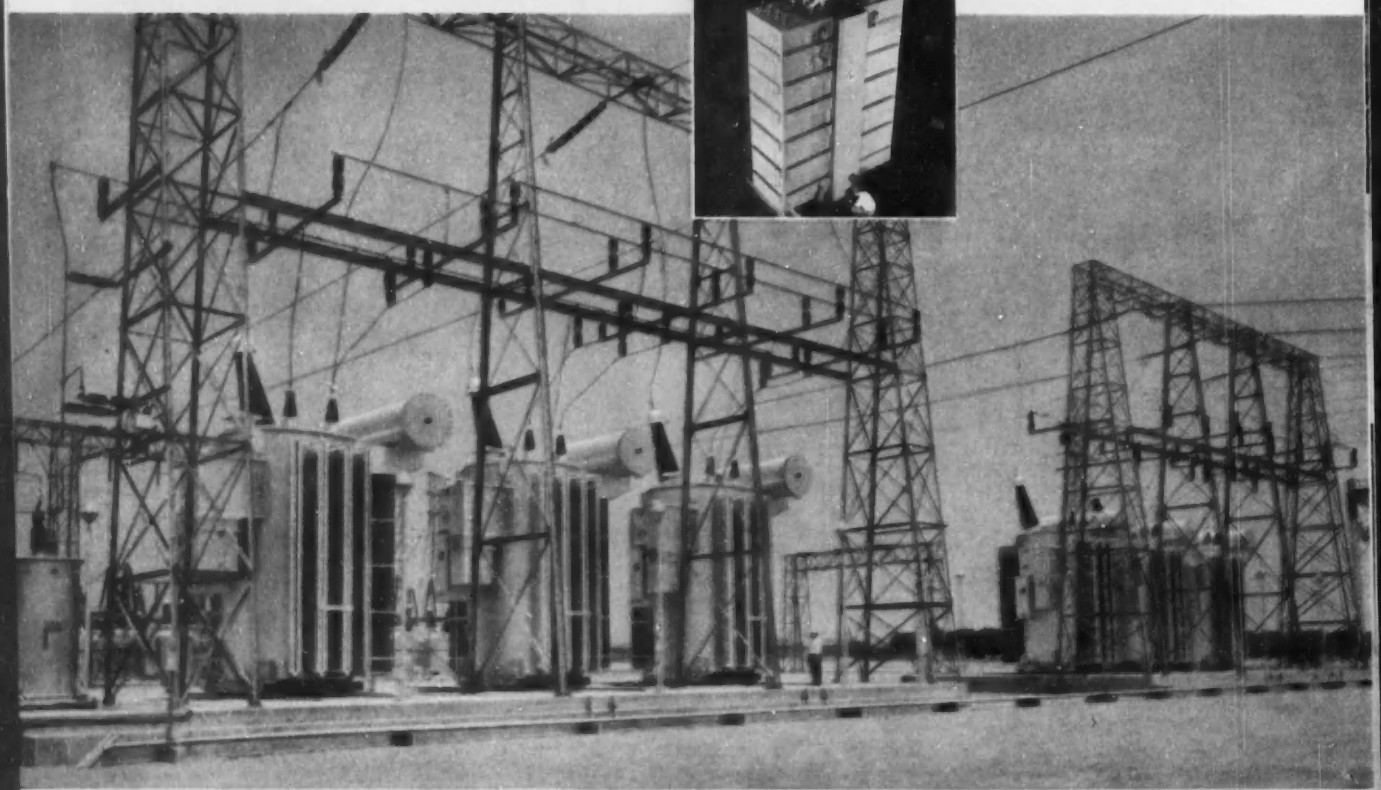
To be ready for tomorrow's requirements, and to add to today's design information, A-C designed and built the 600-kv unit shown below. Tested at design levels and then taken up to breakdown, this pioneering unit has been rebuilt and is now available for testing future extra high voltage power transformers.

This combination of practical experience and development work is your assurance that you can depend on A-C for transformers engineered to meet your requirements . . . all, of course, incorporating *corona-free* design for long, trouble-free insulation life. A-4294

At right: Capable of operation on 600-kv transmission line now — possibly on 880-kv line in the future, this 5000-kva commercial-type power transformer proves that Allis-Chalmers transformer engineering is ready for transmission voltages far beyond present levels.



Below: Two 90,000-kva banks of load ratio control transformers on 230-kv lines of Southern California Edison Company.



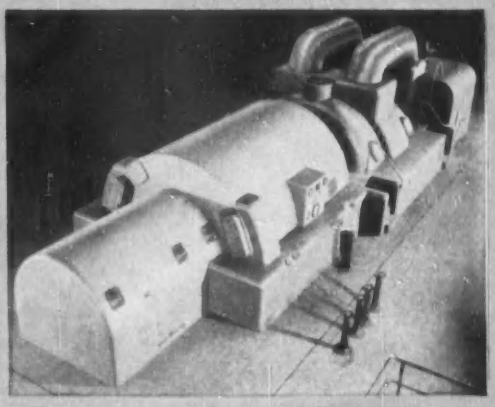
Equipment for Power: Water Conditioning equipment, chemicals and service . . . Steam and Hydraulic Turbines . . . Generators . . . Condensers . . . Steam Jet Air Ejectors . . . Power Plant Pumps and Motors . . . Transformers . . . Circuit Breakers . . . Switchboards and Control . . . Switchgear . . . Unit Substations . . . Utilization equipment.

ALLIS-

in Power Equipment

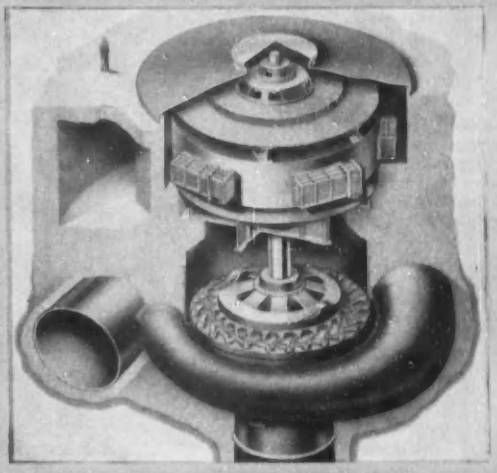
First *Supercharged* Generators

By cutting generator size, supercharged hydrogen cooling permits smaller plant size, lower foundation and crane costs, and smaller breaker and bus structures; now, maximum turbine-generator unit ratings are not limited by mechanical design. A-C turbine generators built for direct rotor conductor cooling have proved themselves in commercial service. The first of these — the world's first supercharged unit — has established a 99.86% availability record during its two full calendar years of operation. And A-C is building a fully supercharged generator affording further economic advantages.



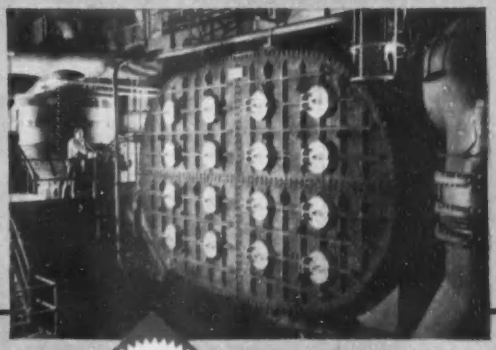
Reversible Pump-Turbine Units

Pioneered by Allis-Chalmers, reversible pump-turbines can solve some troublesome peak load problems. They do this by reducing the amount of equipment formerly needed for pumped storage operation; the single unit operates alternately as a turbine-generator and as a motor-driven pump. One 20,000-hp pump-turbine is now in operation, and four others are in production, with turbine ratings ranging from 12,650 to 120,000 hp. The latter will combine the world's largest motor, with a rating of 102,000 hp, and the largest Francis turbine ever built.



Multi-Steam-Path Condensers

Allis-Chalmers is supplying six 100,000 sq ft surface condensers for the 2,200,000 kw of added private utility capacity being provided for AEC's Ohio diffusion plant. A-C multi-steam-path condensers have consistently helped to cut power costs. With 60 years of experience building over 13,000,000 sq ft of condenser capacity, A-C has the proven engineering and manufacturing facilities to build the largest condensers that might be required.



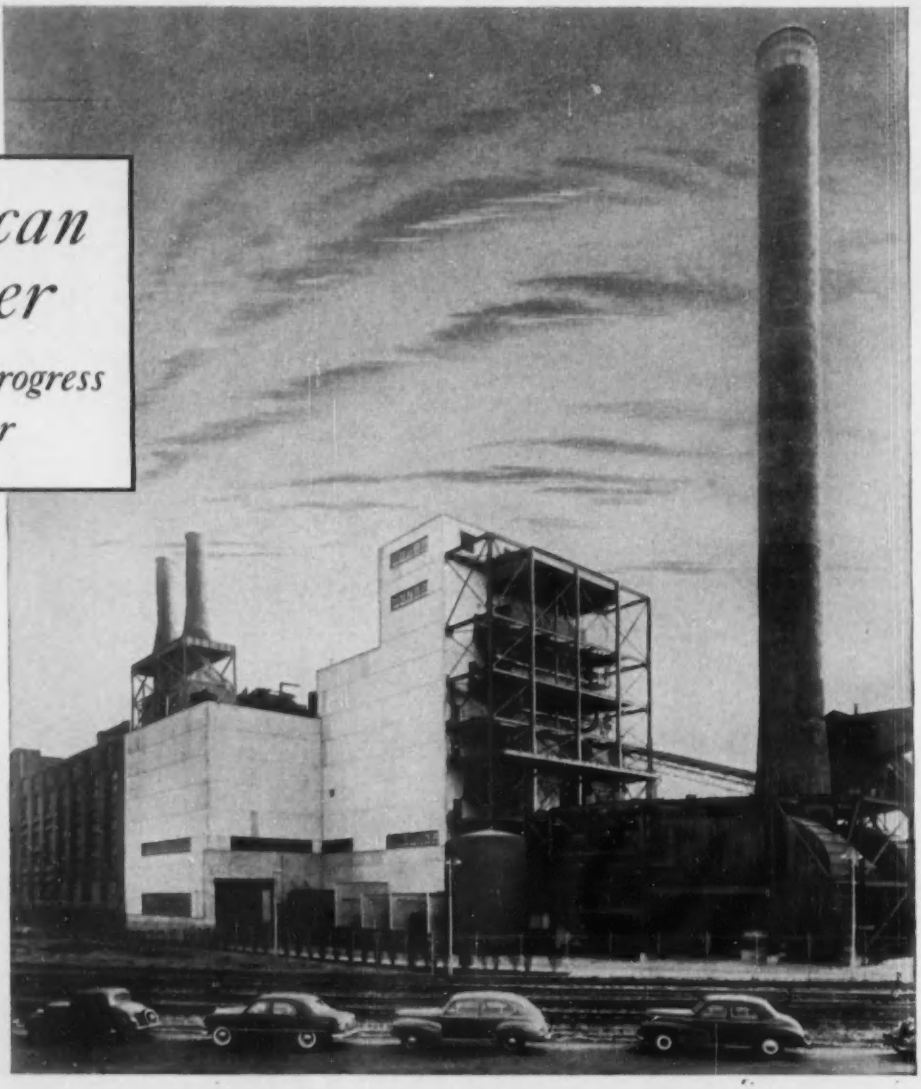
CHALMERS

A-C ALLIS-CHALMERS

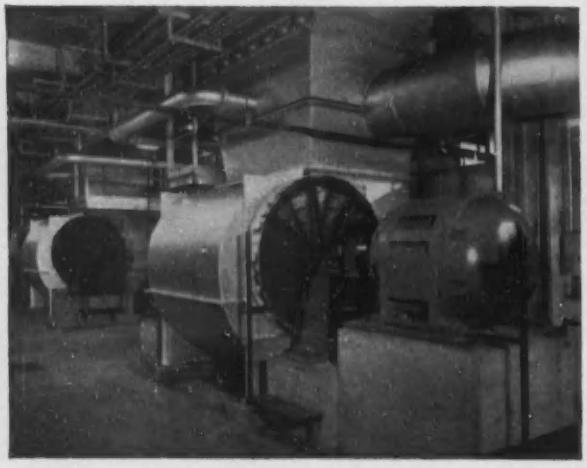
For more information, contact your nearby A-C representative, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

American Blower

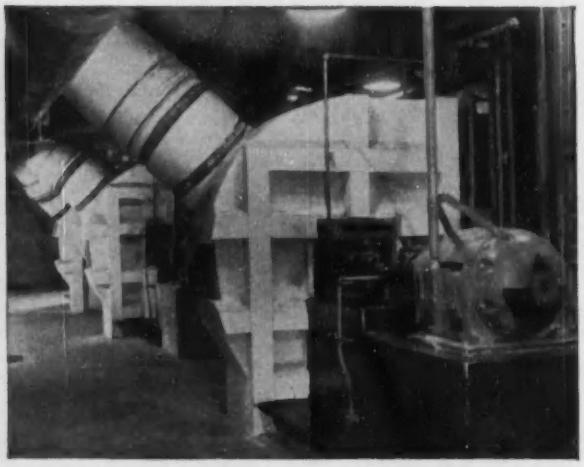
Reports on progress in power



Consolidated of Baltimore's new No. 3 Unit (foreground) at the Gould Street Generating Station has a capacity of 100,000 kw.



Placed in service in December, 1952, the Gould Street Station's No. 3 Unit is served by these two inlet-vane-controlled American Blower Forced Draft Fans.



Three American Blower HS Pulverizer Fans are used in the 75,000 kw. No. 5 Unit at Riverside Generating Station. Total capacity of the plant is 350,000 kw.

Consolidated of Baltimore Triples Generating Capacity in 20 Years

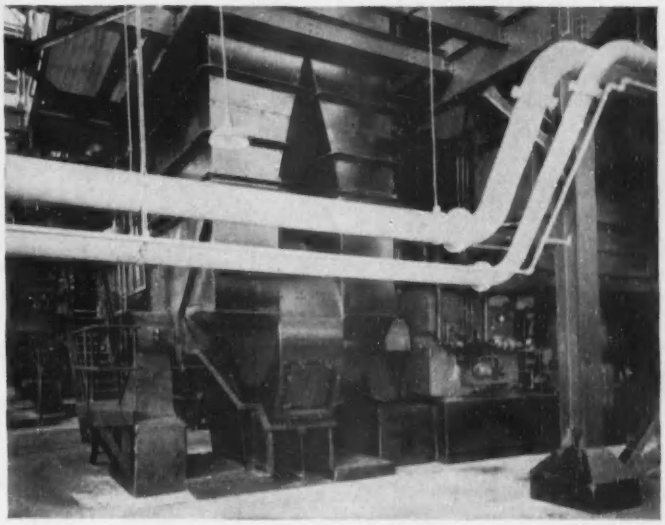
Farsighted program boosts total capacity to 830,500 kw.

Consolidated Gas Electric Light and Power Company of Baltimore serves a 2,283 square mile territory. To meet the rapidly growing needs of its customers, Consolidated of Baltimore must plan for the future — *years ahead.*

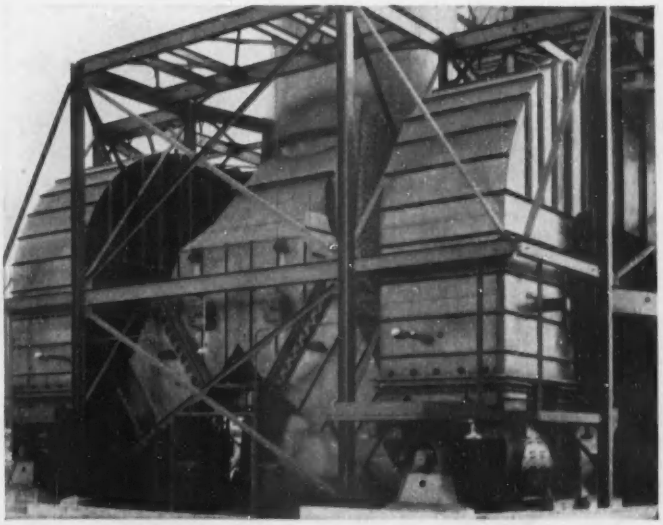
In the past 20 years, electric generating capacity of the company has been increased 3.48 times, from 238,850 kw in 1933 to 830,500 kw in 1953. In addition, completion of the first 125,000 kw unit of the Herbert A. Wagner Station (construction is now under way) will bring total capacity to four times the 1933 figure.

Like many other progressive, investor-owned utilities, Consolidated Gas Electric Light and Power Company of Baltimore has found it pays to use American Blower products.

If you are planning to modernize or expand your facilities, consult your nearest American Blower Branch Office, or write us direct for full information on Mechanical Draft Fans, Heavy-Duty Steam Coils, Dust Collecting Equipment and Gyrol Fluid Drives for boiler feed pumps and fan control.



Gyrol Fluid Drives are used for smooth adjustable speed control of both American Blower Induced Draft Fans (one shown here) at Riverside Station's No. 5 Generating Unit.



Two American Blower Induced Draft Fans are installed in the No. 3 Steam Generating Unit at the Gould Street Station. Units 1 and 2 also use American Blower Induced and Forced Draft Fans.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

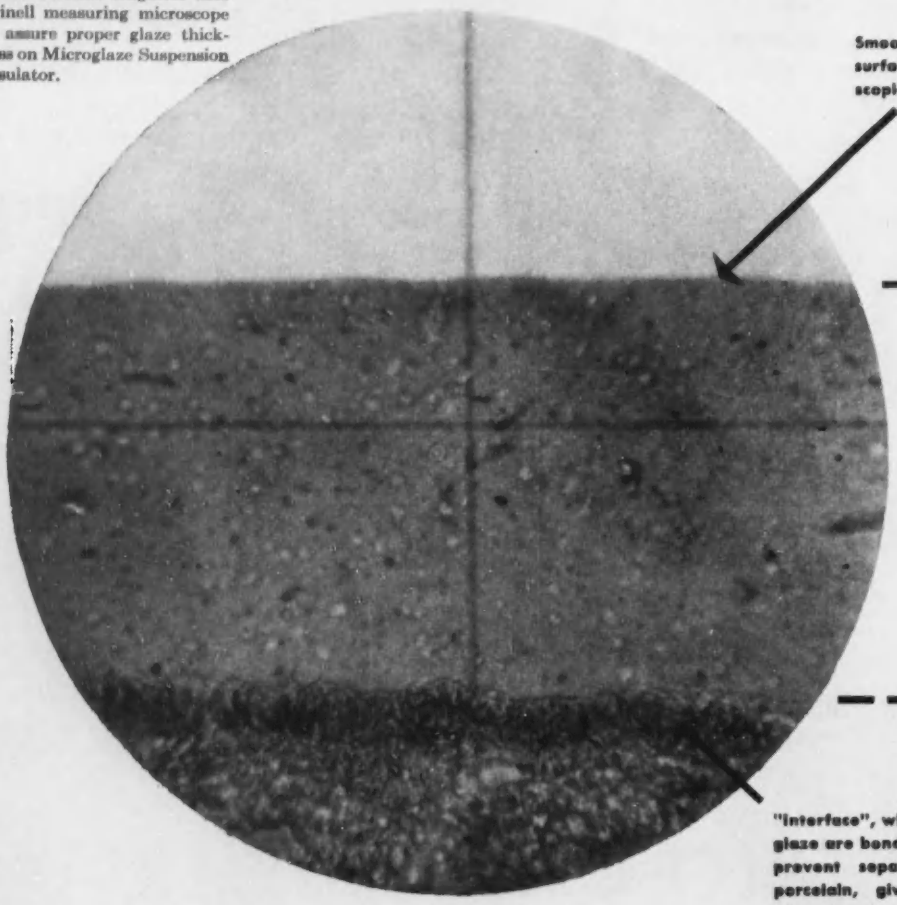
Locke reports new facts about

GLAZE THICKNESS and

Research into their relationship leads Locke to develop . . .

Locke Ceramic Engineer uses Brinell measuring microscope to assure proper glaze thickness on Microglaze Suspension Insulator.

Photomicrograph of cross section near surface of Microglaze Suspension Insulator



Smooth, self-cleaning glaze surface results from microscopic glaze thickness control.

Thickness of glaze, measured between surface and junction with porcelain body is controlled by Locke to achieve peak strength.

"Interface", where porcelain body and glaze are bonded. Interlocking crystals prevent separation of glaze from porcelain, give added strength to Microglaze Insulators.

INSULATOR STRENGTH

NEW MICROGLAZE SUSPENSION INSULATORS

An insulator's ability to withstand mechanical impact varies with thickness of the compression glaze on its surface. Too much glaze . . . or too little . . . will prevent full development of insulator strength.

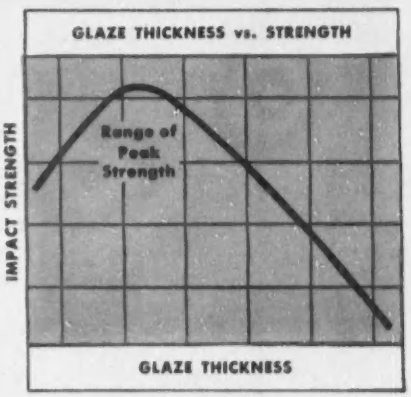
However, laboratory tests show that porcelain with a smooth coat of compression glaze, held within a microscopically narrow range of thickness, will be as much as 40% stronger than improperly glazed porcelain.

Locke has been quick to bring this discovery out of the lab and onto the production line for the benefit of all insulator users.

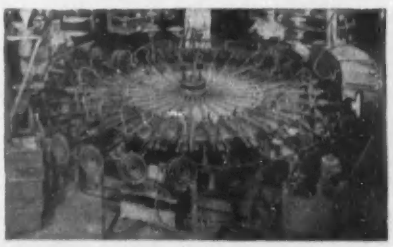
The result is the new MICROGLAZE Suspension Insulator.

Microscopic control of glaze thickness is now applied to these mass-produced suspension insulators, resulting in uniform peak strength, assuring you a new kind of protection . . . and longer, trouble-free insulator service life.

Next time specify MICROGLAZE Suspension Insulators . . . your best insurance yet against the hazards of mechanical impact.



Research in Locke laboratories proves definite relationship between glaze thickness and both flexural and impact strength of the porcelain. Curve shows how impact strength increases with increasing glaze thickness, reaches peak, then drops sharply. On Microglaze Insulators, glaze thickness is maintained within the narrow range which gives *peak* strength.



Accurate glaze thickness control is accomplished by use of this precision glazing machine. As each insulator spins its way around the wheel, it is cleaned, moistened, glazed, exactly the same way as every other. This, combined with special control of many other factors assures uniform appearance, uniform top strength, uniform reliability.

Send today for new 8-page folder titled "The Story of Microglaze Insulators"

LOCKE

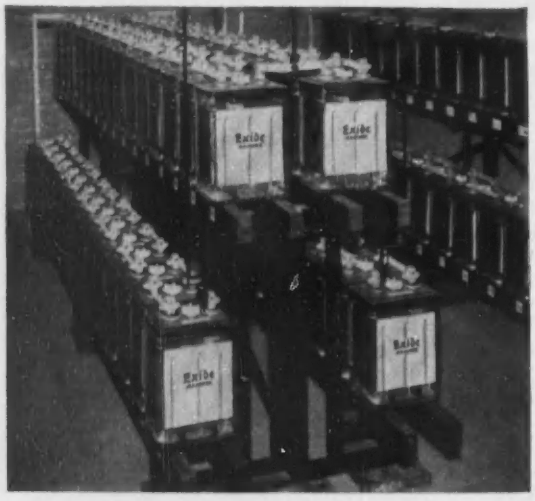
LOCKE DEPARTMENT
GENERAL ELECTRIC COMPANY
BALTIMORE, MARYLAND

*Trademark of General Electric Company

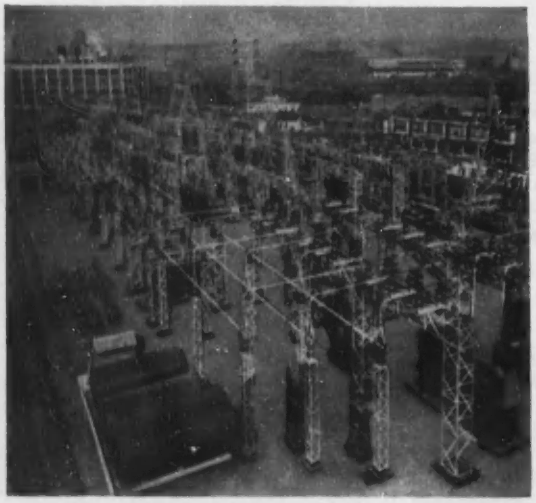
The old Exide battery that lasted for 26 years.

At The Philadelphia Electric Company
26 YEARS BATTERY SERVICE FROM

Exide®
BATTERIES



New installation of 120 EME-11 Exide-Manchex battery at the Westmoreland Substation.



Aerial view of The Philadelphia Electric Company's Westmoreland Substation. This is one of the largest switchyards on The Philadelphia Electric Co.'s system.

Twenty-six years of service—Another example of the long life of Exide batteries! Two 120 E-9 Exide batteries were installed at the Westmoreland Substation of the Philadelphia Electric Company—one in December 1927 and one in February 1928. In January 1953 the December 1927 battery (illustrated above) was replaced with 120 EME-11 Exide-Manchex. The other continues to provide dependable service! Exide-Manchex assures:

POSITIVE OPERATION: Dependable performance at ample voltage with no switchgear failures.

INSTANTANEOUS POWER: High rates for switchgear operation with adequate reserve power for all other control circuits and for emergency lighting.

LOW OPERATING COST: Extremely low internal resistance.

LOW MAINTENANCE COSTS: Water required about twice a year. No change of chemical solution during life of battery.

LOW DEPRECIATION: Sturdy, long-life construction.

GREATER CAPACITY in a given amount of space avoids overcrowding.

• • •

Various sizes and types of Exide Batteries are available in plastic containers.

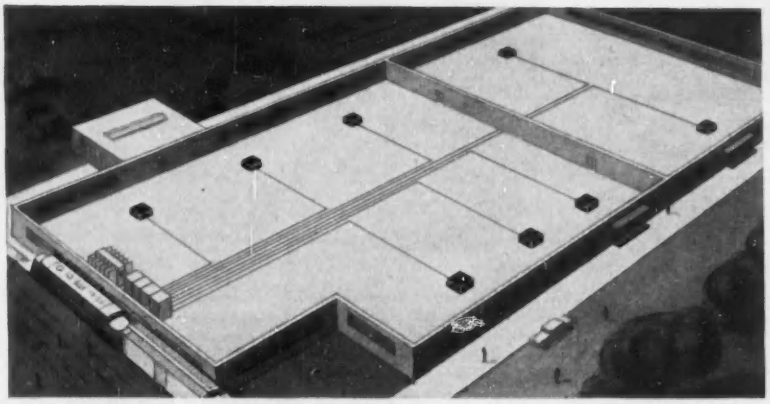
Exide-Manchex® is your best battery buy for all control and substation services.

Exide INDUSTRIAL DIVISION
THE ELECTRIC STORAGE BATTERY COMPANY,
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto

WIRE AND CABLE INFORMATION DIGEST

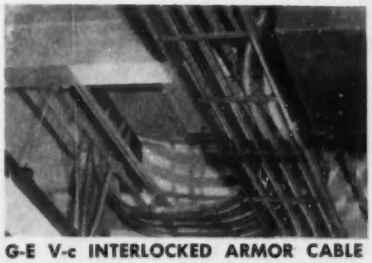
Planned Electrical Modernization

to prepare for growing loads

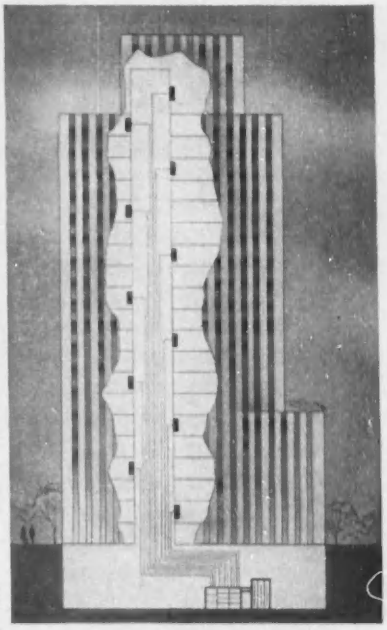


INDUSTRIAL PLANTS. General Electric job-planned cable systems are designed to absorb load increases without major modifications. For example, a feeder system of flexible G-E interlocked armor cables will let you add or relocate circuits easily, as loads increase and circuit requirements change. For incoming leads and primary feeders buried directly in the ground, installed in underground ducts, or in conduit, G-E Super Coronol* cable's normal rating (85 C up to 8,000 volts) and its emergency rating (up to 115 C depending on the voltage) give you reserve capacity.

Registered Trade-mark General Electric Company



G-E V-c INTERLOCKED ARMOR CABLE primary or secondary feeder systems can be installed quickly, and can be easily expanded or relocated to accomodate changes in load patterns—because each circuit is a separate, flexible cable that needs no conduit.

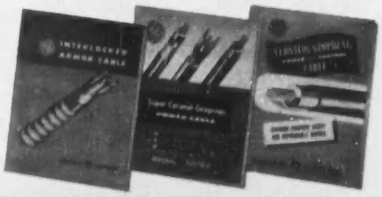


MULTI-STORY BUILDINGS. Growing loads here can be met by running primary feeders up the service shaft, and stepping down to utilization voltage on the upper floors.

MULTI-UNIT BUILDINGS. In a shopping center, power requirements often change drastically—for example, when air conditioning is added. A G-E cable system, planned for flexibility, solves the problem.

For help in planning a cable system

that allows for future expansion, write for these helpful booklets on G-E cables, or call the G-E wire and cable specialist in your locality. Section W134-527, Construction Materials Division, General Electric Company, Bridgeport 2, Conn.



REWIRE AMERICA ... WITH GENERAL ELECTRIC WIRING SYSTEMS

Progress is our most important product

GENERAL ELECTRIC

NEW UTILITY STATIONS C-E EQUIPPED

Includes stations placed in operation since the war (in white) and those under construction or being engineered.

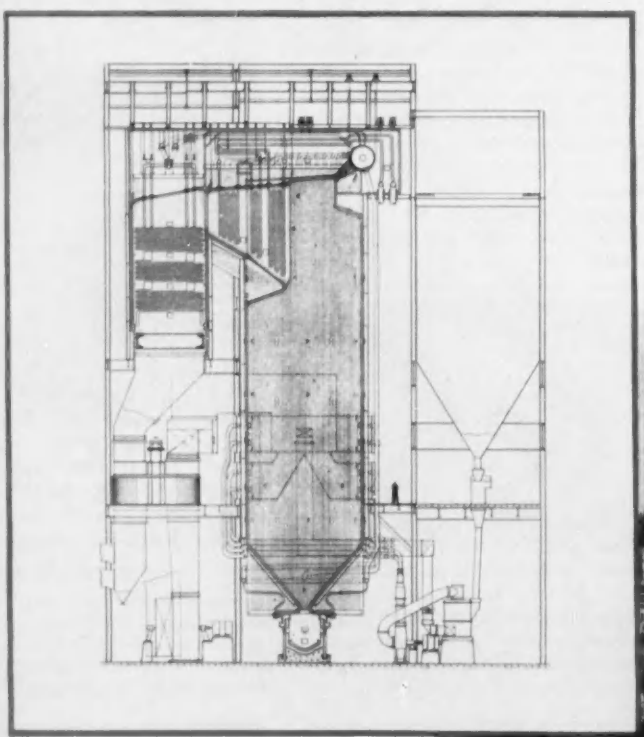
TIDD • JENNISON
CECIL LYNCH • HAVANA
MEREDOSIA • PERMIAN BASIN
O. H. HUTCHINGS • REX BROWN
HICKLING • B. C. COBB
RUSSELL • SEWAREN
POSSUM POINT • CUTLER
PORT JEFFERSON • WHITE RIVER
POTOMAC RIVER • GADSDEN
W. SPRINGFIELD • WOOD RIVER
DAN RIVER • LAKE CATHERINE
HARRY NEWMAN • JIM HILL
HUTCHISON • YATES
DUNKIRK • TITUS • LEE
CONTRA COSTA • HAWTHORN
NINEMILE POINT • EDGE MOOR
PALATKA • JOHNSONVILLE
DANSKAMMER • BECKJORD
HIGHGROVE • PLANT X
BLACK DOG • ALBANY
JOPPA • MERAMEC
PORTSMOUTH • LAKE CREEK
ETIWANDA • AURORA
HENNEPIN • EASTLAKE
OAK CREEK • SUWANNEE RIVER
URQUHART

KINGSTON

SANDOW
BARRY
MULLERGREN
NORTH OMAHA
SAGUARO
MILLIKEN
WILMINGTON
JOHN SEVIER
VERMILION
GALLATIN
BARRETT
CARBON

NEW

Two C-E units as shown below are now in service at the new Kingston Steam Plant. Two duplicates are presently under construction, as well as five others of the controlled circulation type. The unit shown is of the radiant, reheat type, with the reheater section located between the primary and secondary superheater surfaces. An economizer section is located below the rear superheater section and regenerative type air heaters follow the economizer. The unit is pulverized coal-fired, employing bowl mills and tilting, tangential burners. Each unit serves a 150,000-kw turbine-generator operating at a throttle pressure of 1800 psi with a primary steam temperature of 1003 F, reheated to 1003 F.



KINGSTON STEAM PLANT
goes into service

Geared to provide firm power for vital national defense and industrial plants in the growing East Tennessee area, the first unit of Tennessee Valley Authority's new Kingston Steam Plant was placed in commercial operation February 8, 1954. A duplicate 150,000-kilowatt unit went on the line early in May, and two more will follow at approximately six-week intervals. Five additional units, each of 200,000-kw capability are scheduled to be in service by November 1955, bringing Kingston's ultimate capability to 1,600,000 kilowatts—greater than any other steam plant in the world. On completion, this plant including the switch yard, will represent a total estimated cost of $213,000,000.

Ample reserves of coal are in the vicinity, to supply the plant's eventual demands of more than 4,000,000 tons a year. Located at the base of the peninsula formed by embayments of the Watts Bar Reservoir on the Clinch and Emory Rivers, the plant is assured of an adequate supply of cooling water.

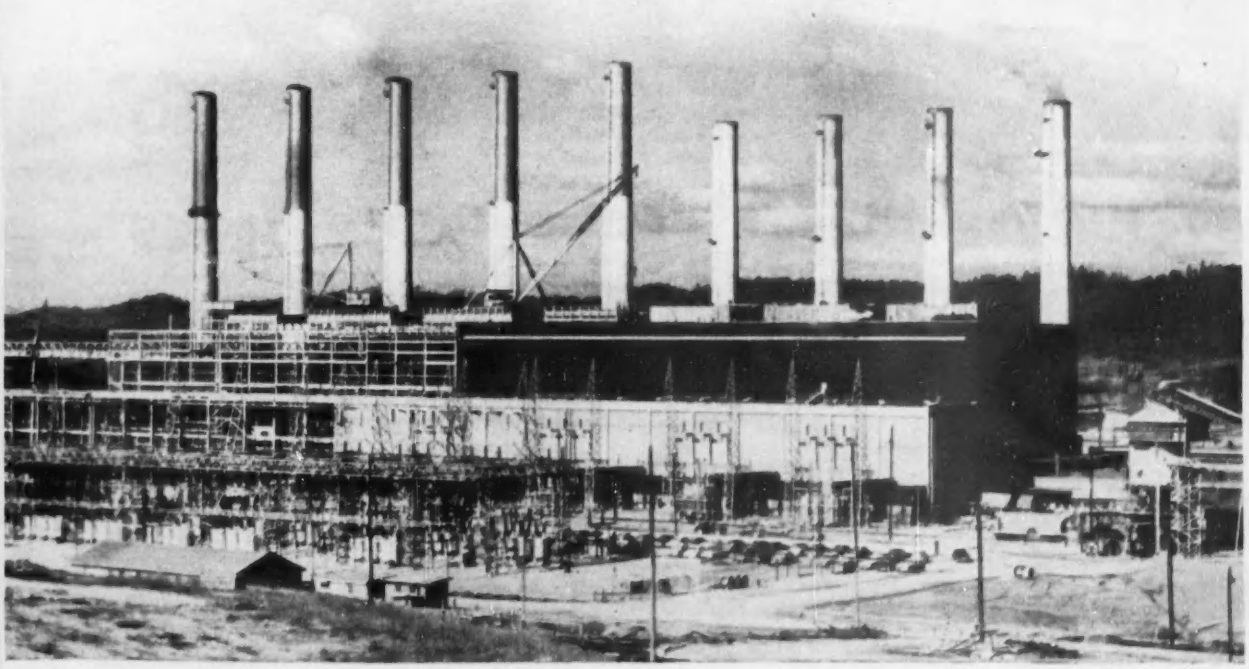
All nine turbine-generators at the new Kingston Steam Plant are to be served by Combustion Engineering Boilers. The four 150,000-kw units will be supplied by C-E Radiant, Reheat Boilers, as illustrated and described briefly on the opposite page; the five 200,000-kw units will be served by C-E Boilers of the Controlled Circulation type.

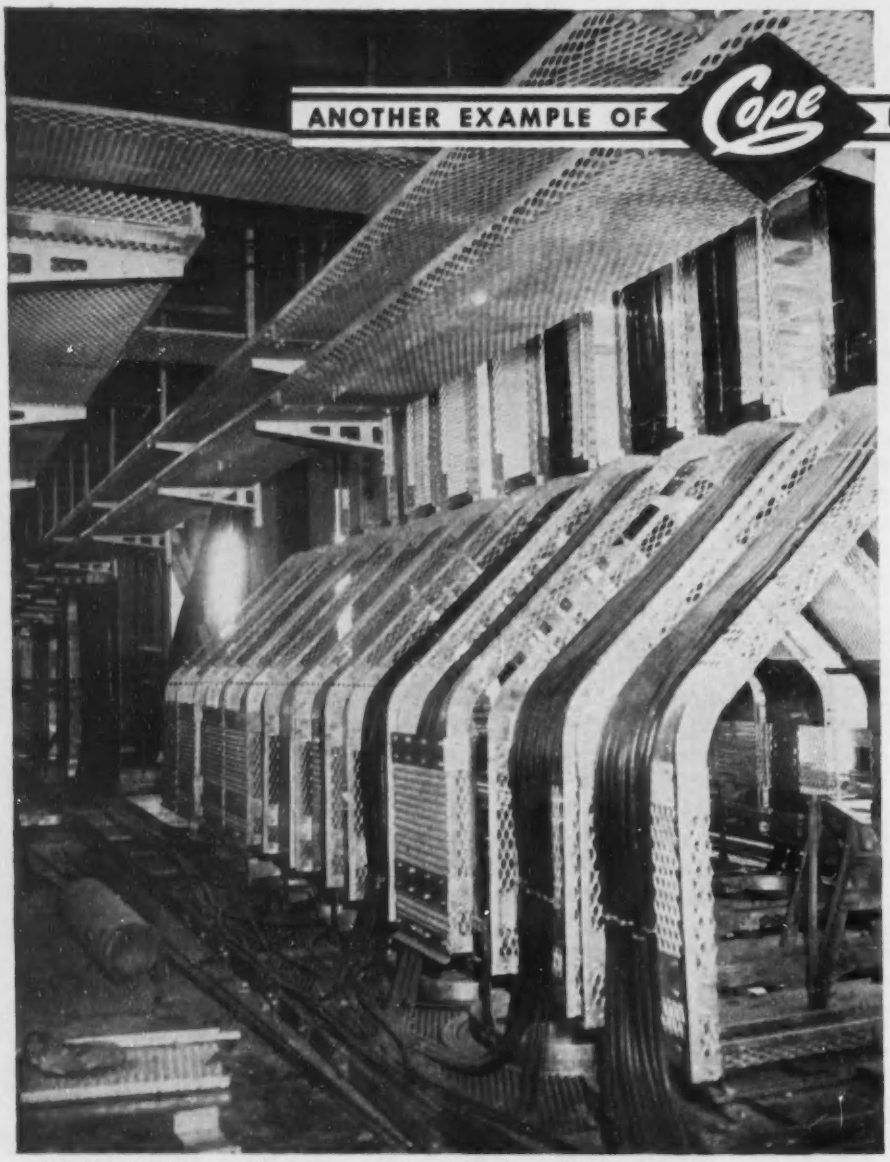
B-750

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE





Ohio Edison Company, Niles Station • Hatzel & Buehler—Electrical Contractors

over 2½ miles of Cope Cable Trough

. . . has been installed in the Ohio Edison Company's new 212,000 kw. steam station at Niles, Ohio, to carry both auxiliary power and control circuits throughout this gigantic structure. All circuits are readily available for maintenance, and sufficient trough area remains for additional cables necessary for future expansion.

The simplification of design through the use of standard parts, plus the ease of installation and the low installed cost, make possible many savings which may be obtained through using COPE Cable Trough.

For further information, write today for Bulletin 5W.

You know Cope by these products

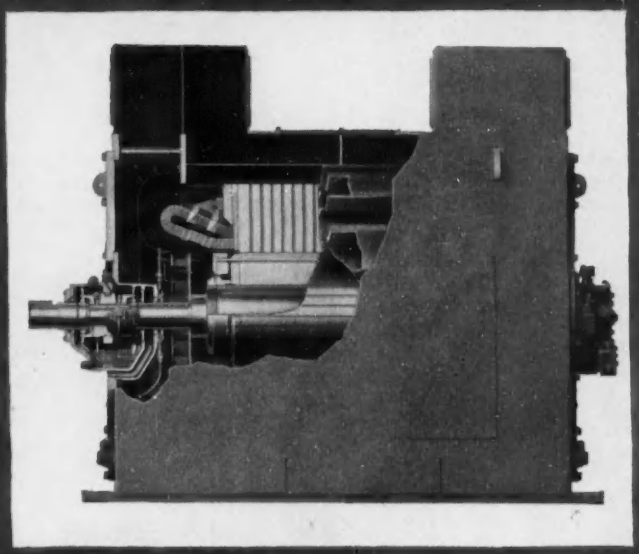
Cope

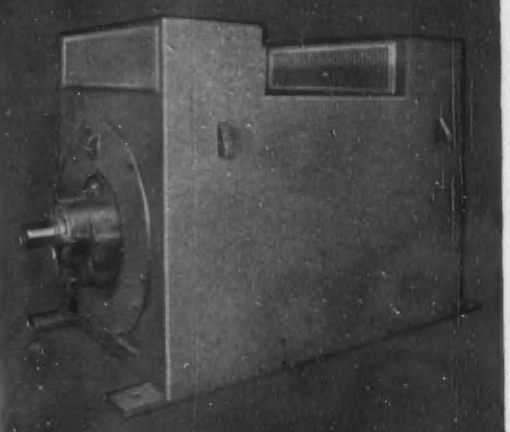
T. J. COPE, INC.

711 SOUTH 50th ST., PHILADELPHIA 43, PA.

Redesigned

INSIDE AND OUT





ALLIS-CHALMERS Boiler-Feed Pump MOTORS

New features improve 2-pole motors long known for reliability and low maintenance.

New ventilating arrangement features top air intake and discharge *plus* spiral stator core ventilation. Top intakes (available with filters) keep motor clean and make motor room cleaning easy; top discharge adds to personnel comfort. Spiral ventilation — used in turbine generators — assures even internal cooling . . . combines with centrifugal fans and baffled air passages to reduce noise.

Improved bearing design simplifies maintenance, prevents oil leakage. Capsule-type housings — proved in use on other designs — permit inspection of windings without exposing bearings. Oil leakage is prevented by a combination of features, including orifice-metered oil flow, weirs to maintain correct oil level, labyrinth seals, breathers, and annular pressure chambers with atmospheric relief.

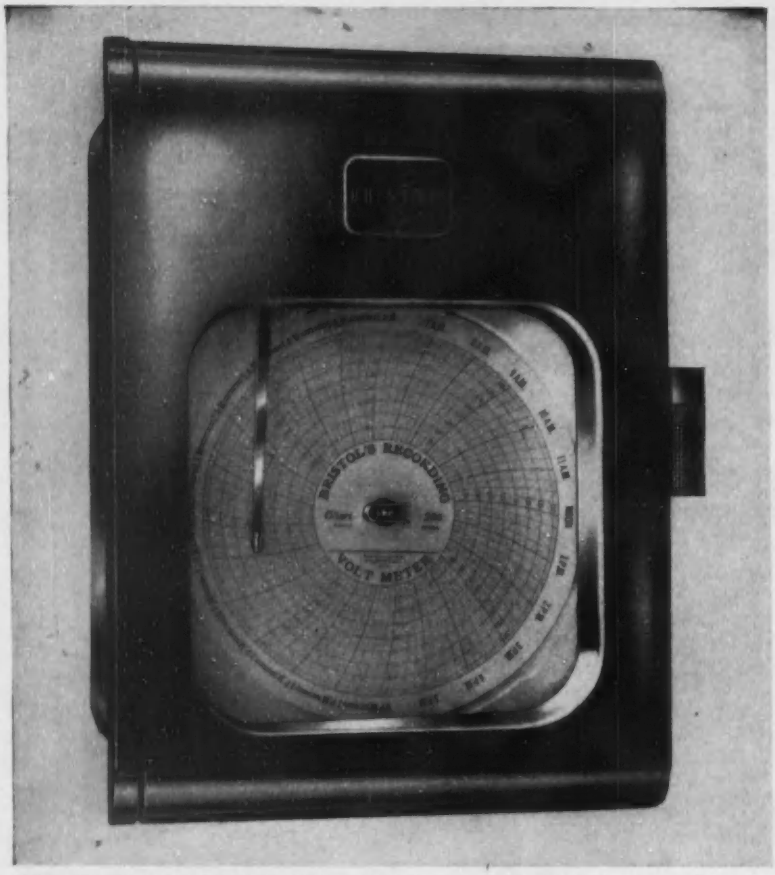
Clean-cut appearance is gained by providing internal space for stator and auxiliary leads, etc.

Features that helped build the Allis-Chalmers 2-pole motor reputation for reliability are retained in the new design. These include proven stator coil design, ample stator coil end bracing, thermally and mechanically stable cage assembly, separate balancing rings, and oxygen-free dew-drop cage bars.

This design available in ratings 900 hp and larger. Ask your A-C representative for Bulletin 05R8123. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4350

ALLIS-CHALMERS



NEW, EASY-TO-READ BRISTOL RECORDING VOLTMETERS AND AMMETERS are available for permanent mounting or for use as portable instruments.

You'll get greater accuracy, greater dependability with Bristol recording voltmeters and ammeters

Here's why:

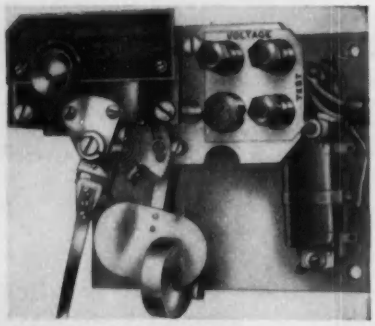
1. Low electrical burden – the lowest burden of any round-chart recorder on the market.
2. Extremely high torque gradient.
3. Temperature compensation.
4. Shock-proof measuring mechanism mounting.
5. Leveling of instrument not critical.
6. Continuously legible recording of sudden changes – up to full scale value.

These modern units are designed for easy use, with dust- and moisture-proof die-cast aluminum case; quick-set chart hub for easy chart changing; non-obscuring pen lifter; and snap-on chart plate.

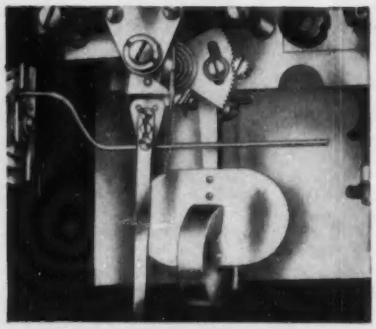
Get the whole story on these precision instruments. Write today for free 28-page Bulletin E1111 to THE BRISTOL COMPANY, 116 Bristol Road, Waterbury 20, Conn.

Many ranges carried in stock for immediate delivery

LOOK AT THESE FEATURES!



NEW MEASURING MECHANISM – High-quality, accurate, dependable Bristol moving-iron mechanism used in all models.



MAGNETIC DAMPING – all models equipped with aluminum vane and alnico magnet damper which gives maximum speed of response possible with minimum overshoot.

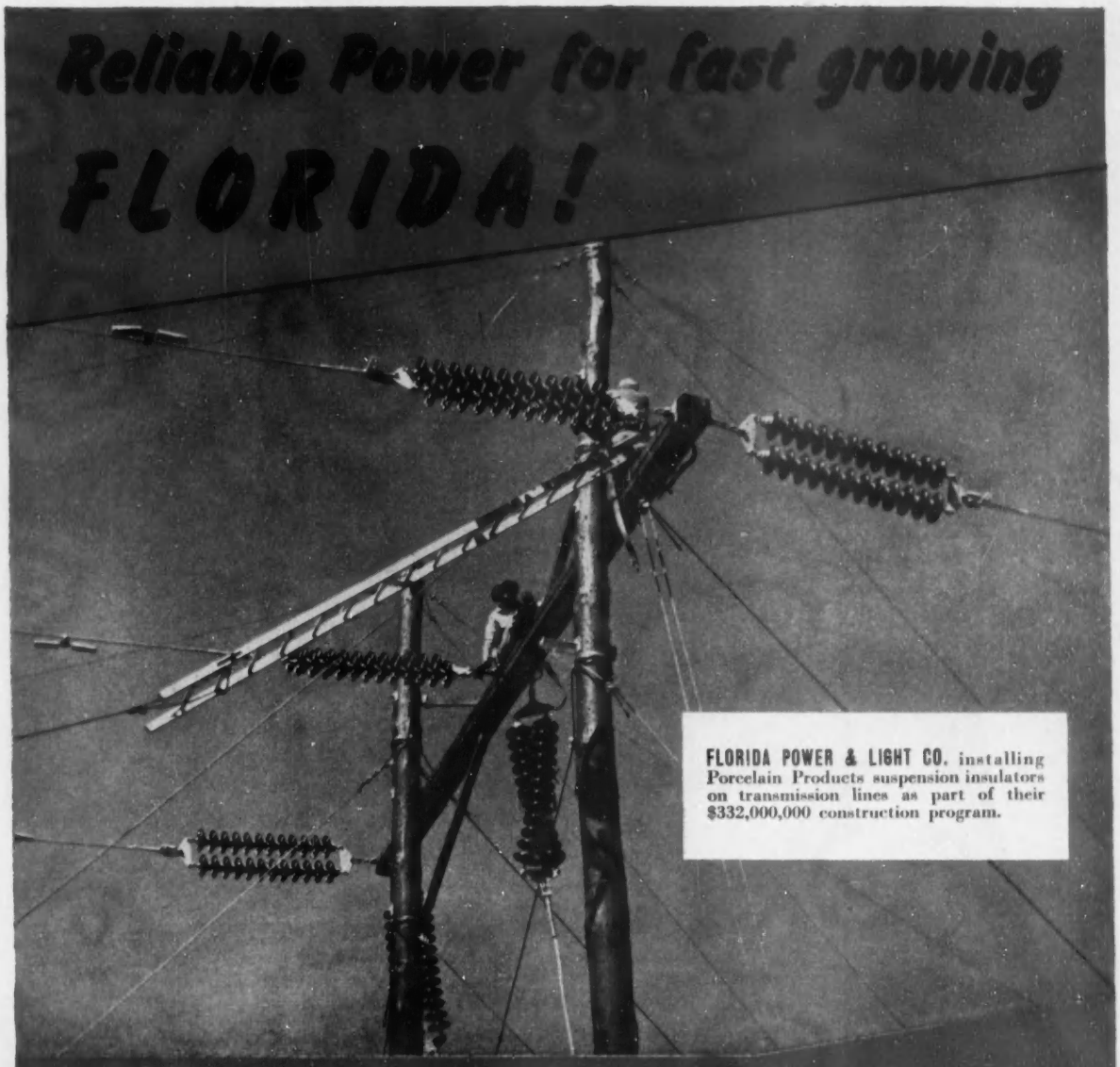
PEN MOUNTING – Pen-arm mounting shaft firmly supported at both ends – eliminates trouble from back-lash and lost motion. Pen arm is readily removed and replaced.

BRISTOL

POINTS THE WAY IN HUMAN-ENGINEERED INSTRUMENTATION

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

Reliable Power for fast growing FLORIDA!

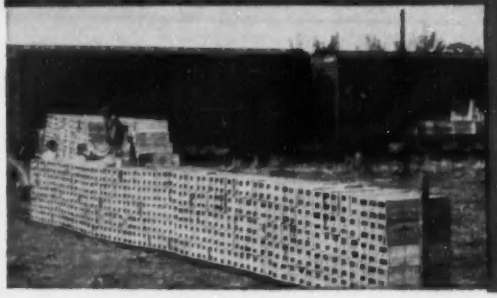


FLORIDA POWER & LIGHT CO. installing Porcelain Products suspension insulators on transmission lines as part of their $332,000,000 construction program.

One of the most steadily-growing states in all 48—that's Florida, with retail sales alone up 44% in the past five years. Yes, everything is growing bigger and faster in fabulous Florida—population, industry, and agriculture!

And pacing the progress of the Sunshine State is Florida Power and Light Company. Currently engaged in a $332,000,000 ten-year construction program FP&L has more than tripled its system capability since 1945.

Electricity, essential to expanding population and industry, must be conveyed across many miles of Florida terrain. In order to support and insulate this vast network of wires, FP&L buys thousands of Porcelain Products Transmission Insulators.



These ten-inch suspension insulators, noted for their high quality, mechanical-electrical strength, resistance to thermal variation and corrosive salt air, cut maintenance and replacement costs to a minimum—assure dependable electric service for FP&L customers.

PP INC.

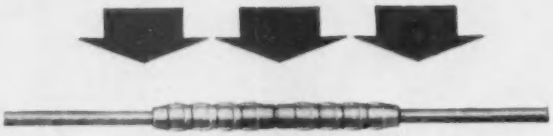
YOUR INDEPENDENT INSULATOR MANUFACTURER

Porcelain Products, Inc.

PARKERSBURG, W. VA.

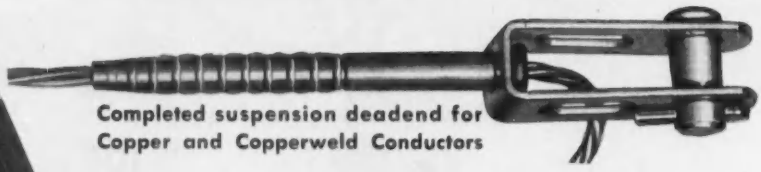
"JOB PROVEN" THE WORLD OVER Nicopress

Nicopress 53-XPJ
3-Groove Tool
with X, P, & J grooves



Completed splice on Solid Copper Conductor

Completed splice on Copperweld Conductor



Completed suspension deadend for
Copper and Copperweld Conductors

Partially completed reinforcing sleeve on Copperweld

Nicopress sleeves and tools are available in a complete range of sizes for Copper, Copperweld, All-Aluminum, and A. C. S. R. Conductors.

Nicopress Sleeves and Tools Patented in U. S. and Foreign Countries. "Nicopress" Registered in U. S. and Foreign Countries.

The National Telephone Supply Company

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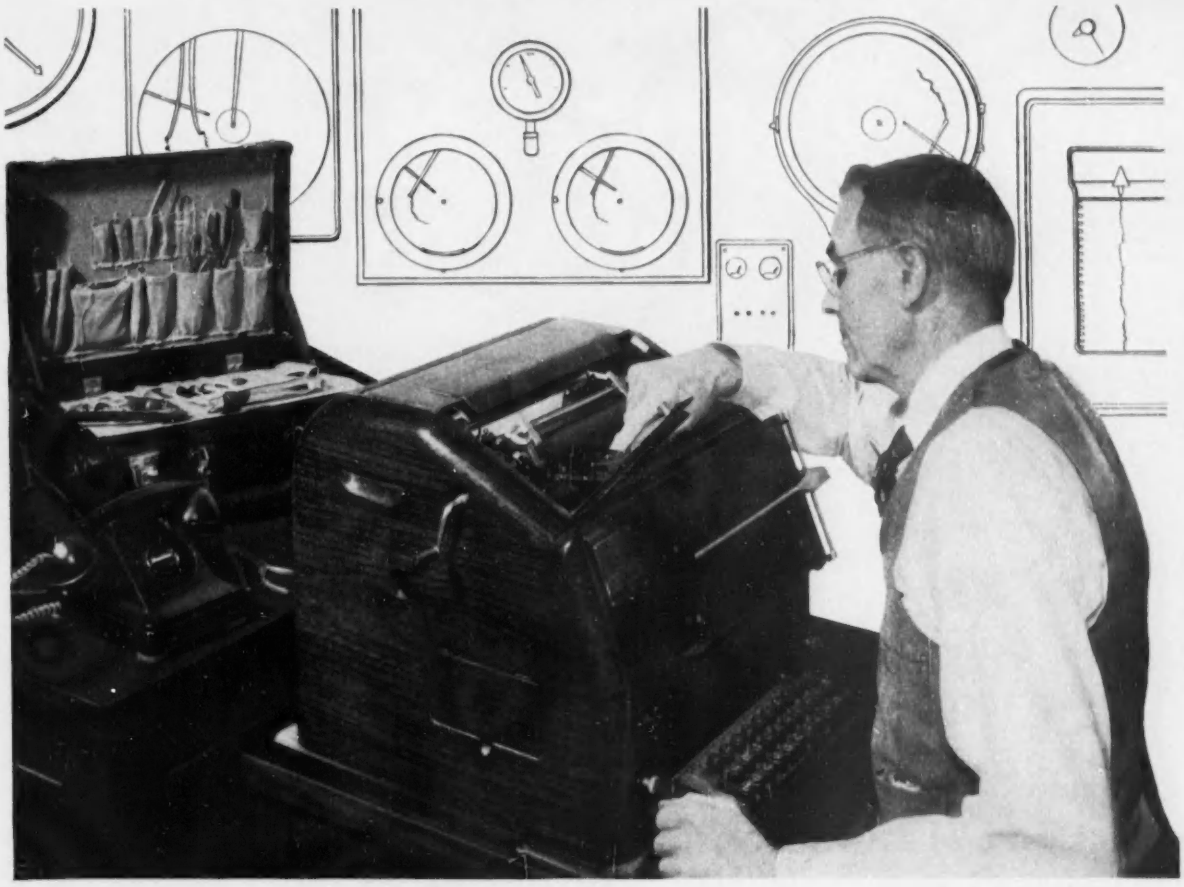
Canadian Mfr.—N. SLATER CO., LTD., HAMILTON, ONT., CANADA

Export Distributor—INTERNATIONAL STANDARD ELECTRIC CORP., NEW YORK, N. Y.



When your communications are installed, Bell System service has just begun!

Installation of communication equipment is just the beginning of your Bell System service.

Behind every piece of equipment stands an army of trained technicians. Their skills are the end product of Bell System's 78 years of communications experience.

The work of these specialists is one reason for our remarkable record of reliability in the power field. From research through manufacturing, installation, operation and maintenance, Bell System people are on the job continually. They make sure that you get the finest communications service in the world.

Whether you need private-line telephone, mobile telephone or teletypewriter service, or channels for remote metering and supervisory control, get Bell System experts on *your* team.

• • •

Your Bell Telephone Company will be glad to study your communications problems and needs without charge.

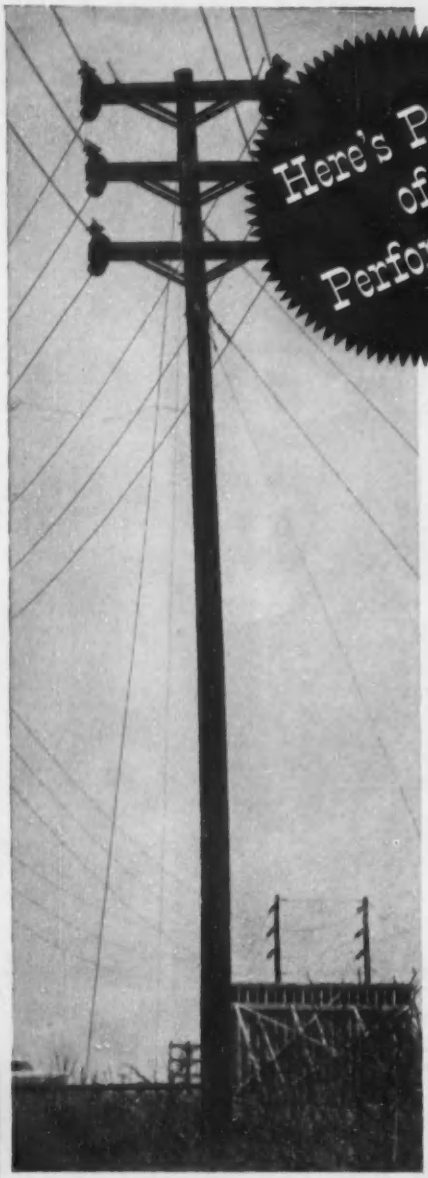
PRIVATE-LINE TELEPHONE

TELETYPEWRITER

MOBILE TELEPHONE

METERING CHANNELS

BELL TELEPHONE SYSTEM



Since 1932, has used only and annual

THIS 65-FOOT pressure-creosoted pole carries transmission lines between the Clark and Sewaren substations of Public Service Electric and Gas Company.

PUBLIC SERVICE also uses pressure-creosoted poles for its residential distribution lines. These homes, all heavy consumers of electricity, are located in Linden, N. J.

Public Service Electric and Gas pressure-creosoted poles... replacements run less than 1%

• Public Service Electric and Gas Company — supplying seven billion kilowatt-hours to over 225 municipalities in New Jersey—has found pressure-creosoted poles a big economy factor.

From its 90-foot heavy-duty transmission line poles to its 35-foot distribution line poles, Public Service, since 1932, has used nothing but pressure-creosoted Southern pine poles. And nearly all of the pre-1932 poles have had Creosote treatment.

George McCaskie, a Public Service engineer specializing in wood, says, "We have eliminated our major problem—decay at the ground line—through the use of pressure-creosoted poles. Creosote's deep penetration also prevents decay above the ground line.

"Until 1945," Mr. McCaskie continues, "we had a four-year inspection cycle. But pressure-creosoting made it possible to extend this cycle to six years."

Public Service specifies eight pounds retention on poles 40 feet and less in length and ten pounds on poles 45 feet and over.

This is another example of Creosote's ability to lengthen pole life and keep replacements low. It's more proof of performance.

For best results from Creosote treatment, be sure your treating plant uses USS Creosote, a uniform product of United States Steel's tar distilling operations. For complete information, contact our nearest Coal Chemical sales office or write directly to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

PRESSURE-CREOSOTED pole being set after the auger of the earth borer is withdrawn.

BACK FILLING and tamping a new pressure-creosoted pole in Cranford, N. J.

SAMPLE OF WOOD being taken from a pressure-creosoted pole during inspection.

you make the comparison...

Allis-Chalmers will ship completely free of charge to any recognized distribution system a Type JFR distribution regulator *for thirty days of thorough examination.* You can call in your engineers, purchasing people, operating and maintenance men so that they can see for themselves why your system will get more for a regulator dollar from Allis-Chalmers.

ALLIS-CHALMERS 5/8% STEP VOLTAGE REGULATORS

First Step Proves Convenient Service

The first step in examining an Allis-Chalmers distribution regulator shows why you save time and money in service. Untanking is easy because of unit construction. All that is necessary for you to do is disconnect the position indicator and remove a few cover bolts. Then hoist up on the cover-lifting eyes and the complete regulator (mechanism, control and transformer) comes out as a single unit. You can operate it outside the tank too — just energize the control from an external power source.

Design, Construction Prove Long Operating Life

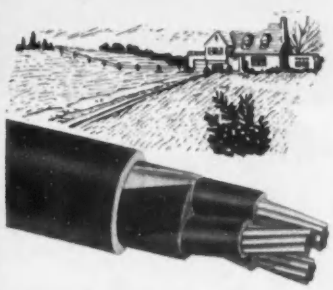
Test the mechanism, for example. Its "tool designer's quality" shows why it withstands five million test operations. Look at the contacts — see their large size and arc-resisting material. No wonder utilities report they last more than a decade with no appreciable signs of wear (actual case histories).

Get complete information — and a copy of the new "regulator check list" that helps analyze all regulators. Call the A-C office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

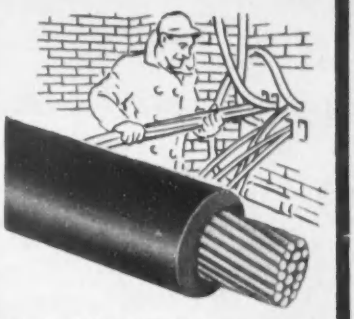
A-4355

ALLIS-CHALMERS

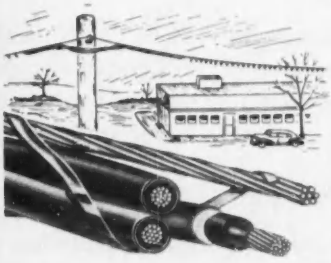
ORIGINATORS OF 5/8% STEP REGULATION



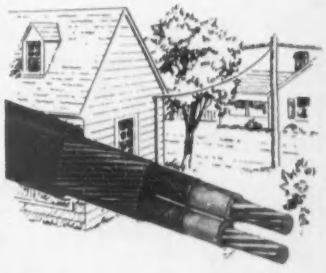
DIRECT BURIAL. Rugged neoprene jacket resists soil acids and withstands pressure of shifting ground throughout its long life.



DUCT AND CONDUIT. Flexible neoprene sheath resists abrasion, cutting and chipping during "pull," protects against electrolytic action.



OVERHEAD. Sun, weather and temperature extremes can't break through the year-round protective barrier of neoprene jacketing.



SERVICE ENTRANCE. No festooning when cable is jacketed with durable neoprene. Cable is flexible, easy to handle, weather-resistant.

Install it—Forget it

NEOPRENE-jacketed cable stays on the job

Wherever it's installed, neoprene-jacketed cable brings the economy of extra-long service life. For neoprene, Du Pont's chemical rubber, is more than a match for extreme conditions of exposure *anywhere* . . . above ground, in ducts, or buried directly in the earth.

Utility companies report important advantages with neoprene-jacketed cable at every stage of installation. It's flexible, easy to handle . . ."soaping" and scuffing are no threat to the rugged jacket. And once installed, it's there to *stay* with a minimum of maintenance care and expense. Your supplier will be glad to tell you about neoprene-jacketed wire and cable—available in single- and multi-conductor types in voltage ratings to meet your requirements.

FREE! The Neoprene Notebook. Every issue brings you illustrated articles . . . on-the-job reports . . . examples of how others cut costs with products of neoprene. Send in the coupon to get on the mailing list.

NEOPRENE

The rubber made by Du Pont since 1932

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

MAIL THIS COUPON TODAY!

E. I. du Pont de Nemours & Co. (Inc.)
Rubber Chemicals Division EW-5
Wilmington 98, Delaware

Please put my name on the mailing list for the free "Neoprene Notebook."

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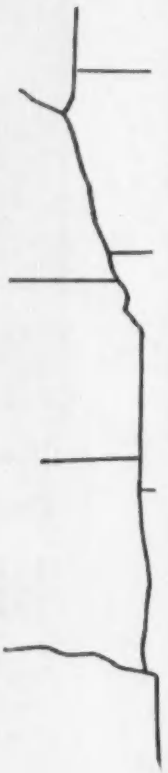
B&W Cyclone Furnace
a growing factor in the



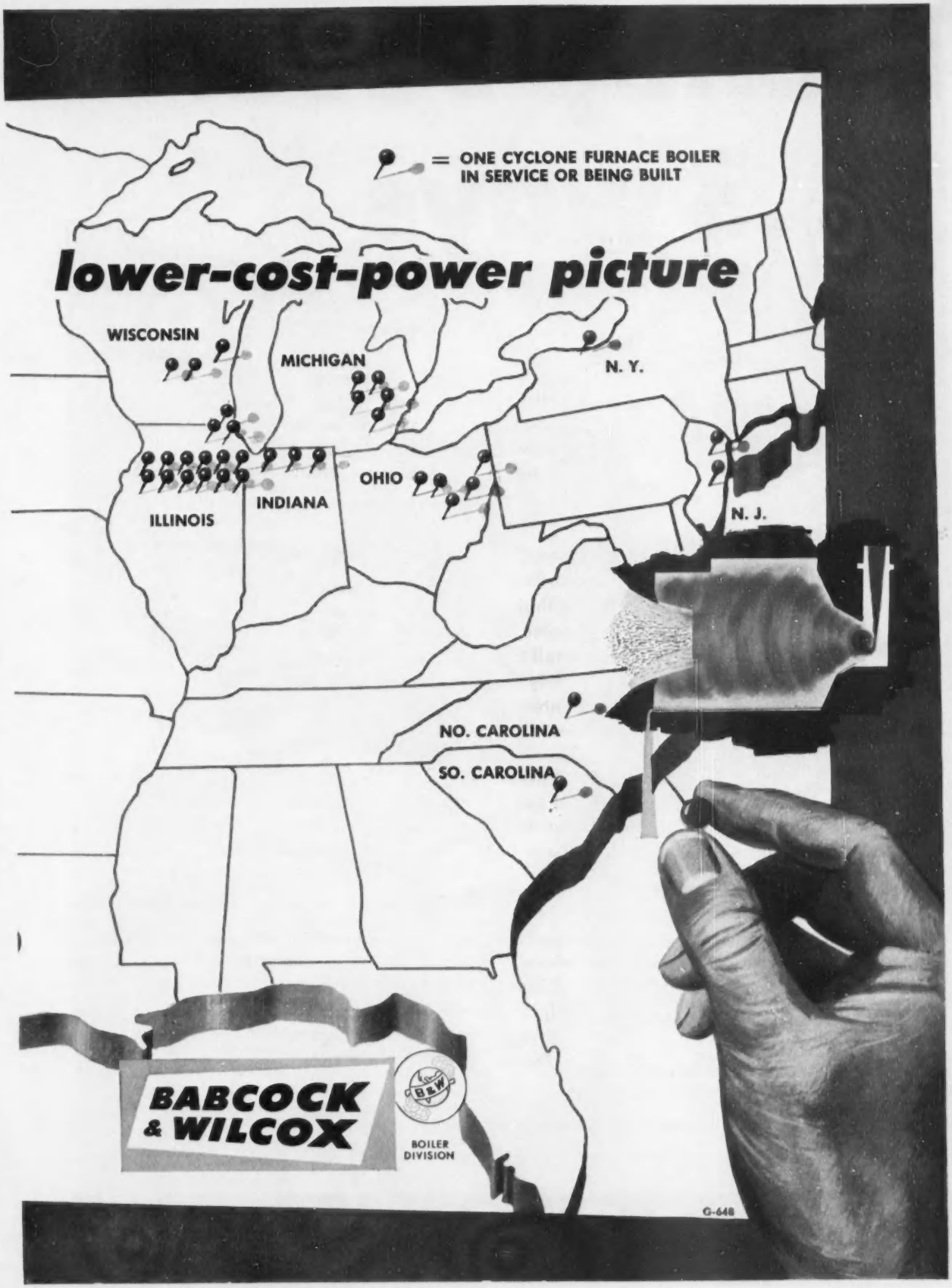
Cost-saving advantages vital to power plant operators are responsible for the mounting acceptance of the Cyclone Furnace. Each represents an important advance in the relentless search of power engineers and designers for more efficient ways to further lower the cost of generating steam for power.

The Cyclone Furnace—

- **Reduces atmospheric pollution to extremely low levels**
- **Simplifies ash handling and disposal**
- **Burns fuel with greater efficiency**
- **Provides greater fuel flexibility with attendant lower costs**
- **Reduces overall first cost**
- **Increases safety by simplifying operation**
- **Reduces maintenance**
- **Increases availability**

Originally designed and developed to burn more efficiently a wide range of coals, as well as oil and gas, the Cyclone Furnace is now being installed in areas where factors other than fuel are prime contributors to higher power generating costs. For whatever the problems — fuel, fly-ash, availability, cost, maintenance — the Cyclone Furnace contributes directly and substantially toward solving them.

With its revolutionary approach to the entire process of preparing and burning fuel, the B&W Cyclone Furnace offers such a simplification of initial design and increased facility in everyday operation, that the overall cost of producing power is greatly benefited. Let us discuss with you the various cost-saving advantages of the Cyclone Furnace for your operation. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.


= ONE CYCLONE FURNACE BOILER IN SERVICE OR BEING BUILT
lower-cost-power picture
WISCONSIN
MICHIGAN
N. Y.
OHIO
INDIANA
ILLINOIS
N. J.
NO. CAROLINA
SO. CAROLINA
BABCOCK & WILCOX
B&W
BOILER DIVISION
G-648

Money-saver ...3 ways

INTERNATIONAL R-110 Series. 115-inch wheelbase. 77-inch Service-Utility body. GVW ratings, 4,200 to 5,400 lbs.

An INTERNATIONAL Truck with Service-Utility body is a sure way to keep job installation and service call expenses down. These *specialized* trucks from INTERNATIONAL cut operating overhead in three important ways.

1. The efficiency-designed Service-Utility body provides big-capacity, compartmented space for orderly, convenient storage of all tools and equipment . . . lets you take the workshop to the job—eliminates the added mileage and wage costs caused by job-to-shop trips for needed items.

2. The modern, thrifty Silver Diamond engine that powers these INTERNATIONALS saves money on gasoline and oil . . . and its rugged all-truck design gives you long-life performance at extra-low maintenance costs.

3. The sturdy, Tough-Job engineered chassis has what it takes to take it . . . keeps trucks on the job. (Service-Utility bodies are available in 77 and 89-inch lengths, for six truck models of 115 and 127-inch wheelbase, and GVW ratings of 4,200 to 6,500 lbs.)

INTERNATIONAL Trucks with Service-Utility bodies are *money-makers*, too . . . because they speed up work, help repairmen and installers do more jobs per day. Ask your INTERNATIONAL Dealer or Branch for complete details. Time payments arranged.

INTERNATIONAL HARVESTER COMPANY • CHICAGO

International Harvester Builds **McCORMICK®** Farm Equipment and **FARMALL®** Tractors . . . Motor Trucks . . . Industrial Power . . . Refrigerators and Freezers

Better roads mean a better America

INTERNATIONAL® TRUCKS

"Standard of the Highway"

WE'VE BROADENED OUR

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- COMPACT DESIGN
- TOP PERFORMANCE
- HIGH QUALITY
- UNEXCELLED STRENGTH
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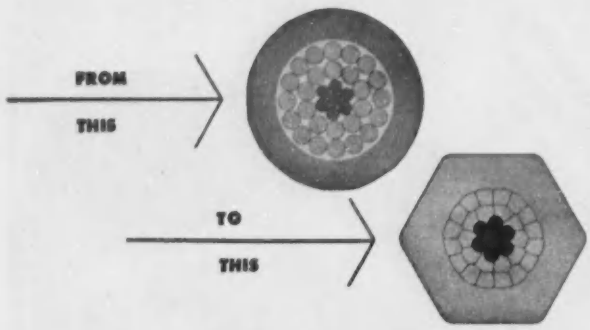
T & B METHOD



. . . IN SECONDS

Compression Dead End

THE STRONGEST CONNECTION FOR ACSR

T & B connector assemblies for dead-ending ACSR develop tensile strengths greater than that of the cable itself. Coated serrations inside the inner clevis barrel provide a sure, certain grip that matches the full strength of the steel core. The aluminum outer compression sleeve assures high conductivity of the joint. Both sleeves are easily installed with light-weight, portable T & B METHOD hydraulic tools which compress joints hexagonally and force the fitting and cable into one homogeneous mass . . . all in a few seconds.

Electrically, T & B Dead Ends offer higher conductance than equal lengths of cable — the one-piece aluminum tube provides uninterrupted current path from cable to jumper loop. During compression, the special serrated T & B compression sleeve penetrates the aluminum oxide film on the *outside* cable strands providing clean overall metal-to-metal contact, as well as minimum current loss. Oxide film on the *inner* strands is also effectively abraded, thereby maintaining a dense, tight joint.

Though the use of an oxide-inhibiting agent is recommended for T & B METHOD aluminum connections, no joint compounds are needed to obtain maximum electrical efficiency.

Investigate the complete line of T & B fittings for ACSR, aluminum cable and copper cable installation — they offer you important savings in time and installation costs. Write for your free copy of T & B Bulletin U-2.

LOOK FOR THIS SIGN —

AUTHORIZED DISTRIBUTION T&B ENGINEERED

IT'S THE MARK OF AN AUTHORIZED T & B DISTRIBUTOR

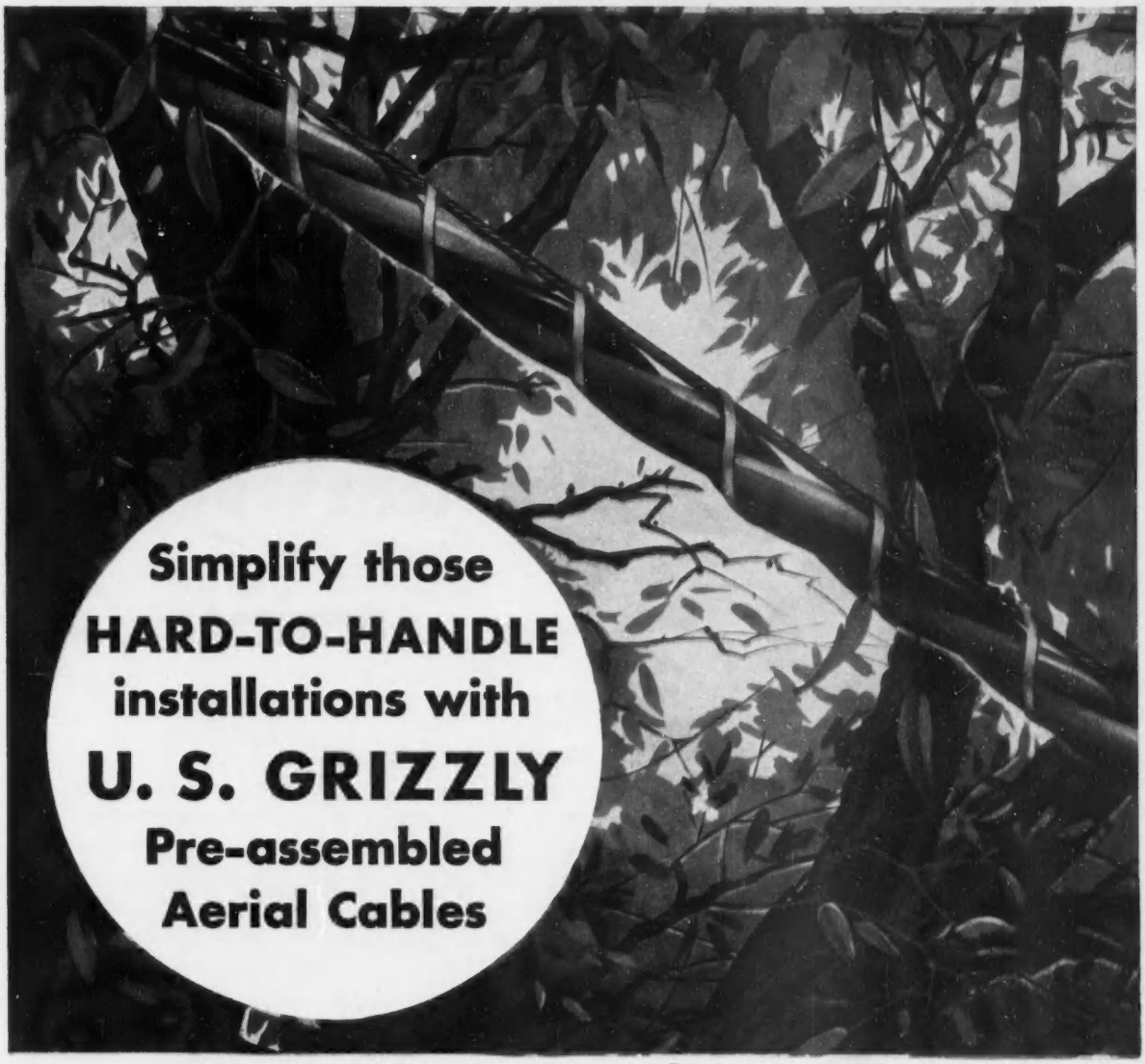
The complete line of T & B fittings for conductors and raceways is sold only by recognized electrical wholesalers. It's our way of assuring you the service and savings of a friendly local source. Call him for all your electrical needs. T37

THE THOMAS & BETTS CO.

INCORPORATED

14 Butler Street • Elizabeth 1, New Jersey
Thomas & Betts Ltd., Montreal, P.Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898



Simplify those HARD-TO-HANDLE installations with U. S. GRIZZLY Pre-assembled Aerial Cables

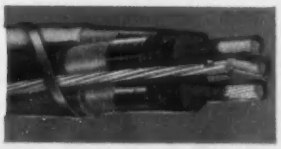
Check the following advantages of U.S. Grizzly® Pre-assembled aerial cables over ordinary open-wiring installations.

1. Less tree trimming is required, and therefore is less objectionable to the community. Can usually be installed in a more direct route.

2. Longer spans and fewer poles due to messenger's great strength.

3. Better appearance because of the elimination of cross-arms and less congestion at the poles.

4. Better service continuity because of high strength supporting messenger.



U. S. Grizzly pre-assembled aerial cable, 15,000 volts. Type RR —3 conductor, Uskor-ona® ozone-resistant insulation — shielded — Neoprene jacket.

5. Better voltage regulation because the conductors are bound closer together.

6. Lower installation and maintenance costs.

7. Permits shorter poles.

8. Made by United States Rubber Company, specialists in electrical insulation, the only electrical wire and cable producer to grow its own natural rubber, make its own synthetic rubber and manufacture its own plastics.

For more information, write to address below.

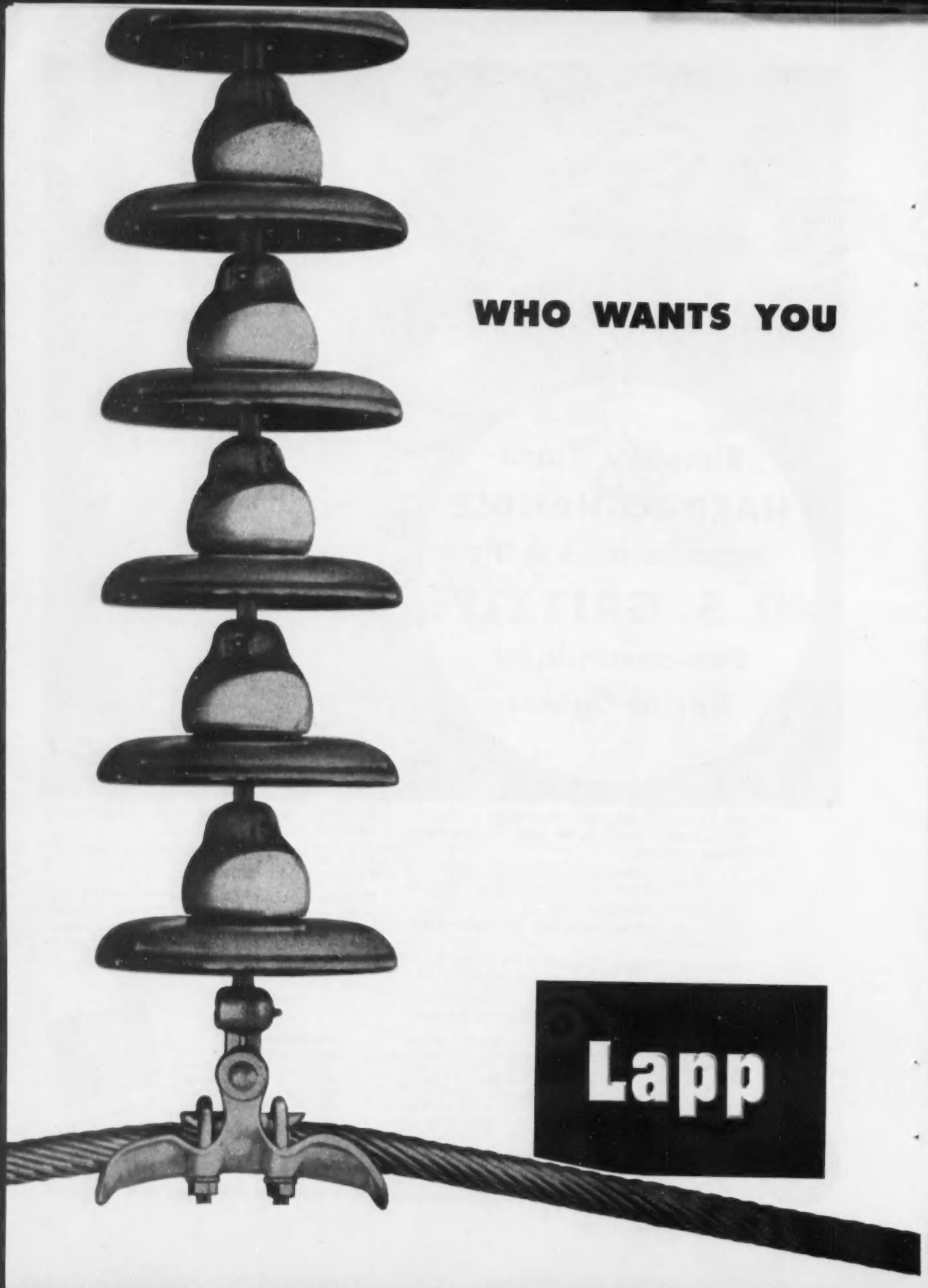
FREE BOOKLET

Write for your copy of free booklet giving full information about U. S. Electrical Wires and Cables for the Electric Utility Industry.

US RUBBER

UNITED STATES RUBBER COMPANY

Electrical Wire and Cable Department • Rockefeller Center, New York 20, N. Y.


WHO WANTS YOU
Lapp

TO THINK THAT "ALL SUSPENSION INSULATORS ARE ALIKE"?

You probably have been told that performance characteristics of various makes of suspension insulators are so nearly alike that it makes little difference which go on your lines. It is true that all "standard" 15,000-lb. suspension discs are of the same diameter. Under the NEMA standardization program, they are similar in appearance. Leakage distances are about the same. Strength ratings are indentical. It is also true that, because of purchases made on a "specification-price" basis, large individual orders have been filled with designs for which there is little experience of service.

Do these similarities wash out all important differences in insulator performance? Lapp certainly does not think so! In fact, we back up our belief with thousands of dollars monthly. We don't think there has ever been much doubt about the ability of any Lapp suspension insulator to meet the "specification"—yet we continue a dozen or more expensive programs of research, development and control. These include design, raw material, manufacture and testing—and they involve electrical and mechanical performance of porcelain, hardware and assembly. They're worth what they cost, because they assure a difference in performance and dependability for Lapp insulators.

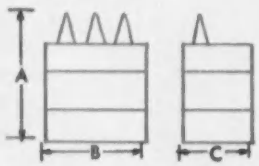
We suspect that the advantage in the belief that "all suspension insulators are alike" is only to the maker of a product which can't compete on a quality or performance basis.

Nobody will offer you a cut-price on Lapp suspension insulators. What we do offer you is a chance to join that select circle of informed and careful buyers who recognize in Lapp suspension insulators the industry's best bargain in operating safety and security . . . long life . . . and low upkeep.

Lapp Insulator Co., Inc., LeRoy, N. Y.

THE ABCs OF TRANSFORMER MANUFACTURE

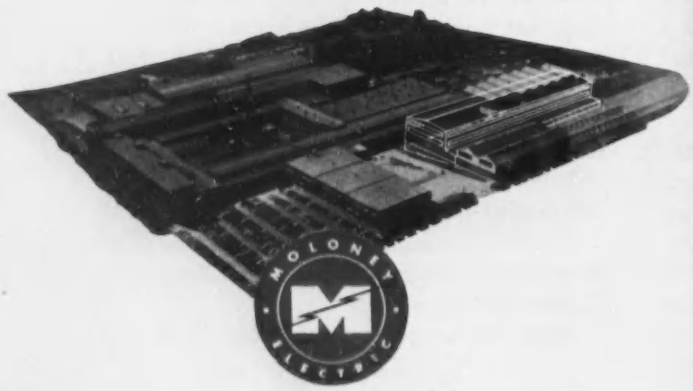
The three dimensions for transformers in the blueprint stage, as shown in diagram, are A, B, and C, the physical measurements of a product. This product would be of little value to today's utility without the coefficient A, B, C of knowledge, facilities, and experience as basic elements of the manufacturer.



The A B C's of transformer manufacture are the combined result of utility demands and manufacturing know-how. Needs expertly calculated by the utilities have made mandatory the possession by manufacturers of A, a high level of knowledge; B, wide facilities; and C, depth of experience.

Moloney is fully qualified in the A, B, C's of transformer manufacture. Since 1896 it has been building and expanding its facilities, its knowledge and its experience to parallel, and to anticipate, utility needs. Now, once again, another long step forward has been taken in increasing facilities here at Moloney so that we can continue to produce transformers capable of superior operation in the high ratings so necessary to today's utility.

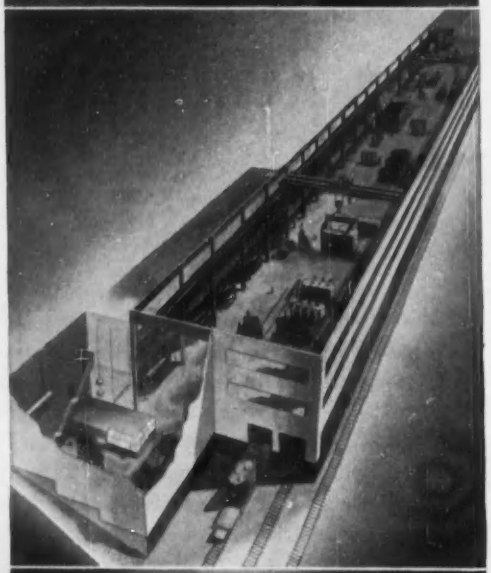
ME54-4

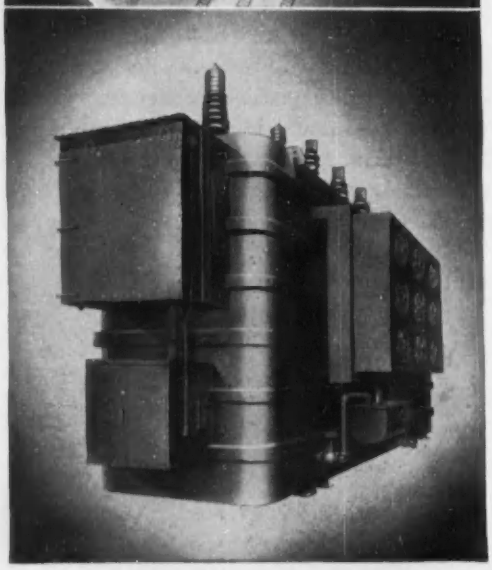


MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations • Electronic Transformers

SALES OFFICES IN ALL PRINCIPAL CITIES





The Greater Benefit

According to latest report from headquarters of Light's Diamond Jubilee, 180 power companies plan celebration activities in 909 cities and towns over the nation. In addition to the many millions of people who will thus be directly exposed to the wholesome contagion of the jubilee, there will be other millions who will learn more or less about it by seeing, reading, and hearing its message in displays, publicity, and advertising. It may be said that before this jubilee year is ended practically the whole population of the country will know at least a little more about what electricity in abundance has done and will do for everyone.

And that will be a great accomplishment, fully justifying the expenditure of time, thought, and money that celebration of the 75th anniversary of Edison's great achievement will have required. But we wonder if a greater benefit than this may not come from the jubilee. A greater benefit can come.

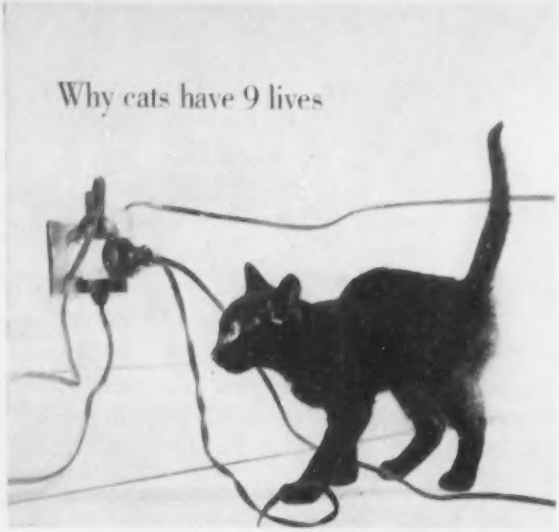
It can come from a quickening of spirit, from an awakened imagination, from a renewal of faith, from more yes-saying and less no-saying, in the industry itself.

Robert Jones, Jr, Democratic Congressman from Alabama, speaking at the recent convention of the American Public Power Association, charged that private utilities have followed market demand for power in adding new capacity; whereas public power systems have established "an enviable record of anticipating future energy requirements." (EW, May 17, p 125).

This charge that the power companies are holding back the electrical expansion of the nation is frequently made by those working for socialized electricity. It is made often enough and by so many voices that it cannot be ignored. Because it is made so frequently and so loudly, it amounts to an indictment of the power companies before the bar of public opinion. In a court of law the truth of an indictment must be proved. But not so in the court of peoples' thinking. It is enough merely to repeat the charge continuously. And the indictment will stick unless definite, conclusive proof of its falsity is hammered home in the public mind.

There is only one way for the power companies to prove the obvious fact that they do anticipate demand and that as always they are leading the electrical progress of this nation. It is for them to speak loudly and often as the leaders of that progress. Some power companies are so speaking. A few are just whispering. All should speak out, not just as serving, but as building the nation with electricity.

If Light's Diamond Jubilee blows higher the flame of enterprise and enthusiasm, that flame, which the American people are being told has been allowed to flicker too low, will in itself produce the jubilee's greater benefit.



EW Adds the Job of Boosting AW

Elsewhere in this issue you will find a two-page advertisement illustrated by the black cat treading cautiously above. The cat has no great significance for the industry; the ad has. It marks the entrance of Electrical World into the promotion beyond its own columns of Adequate Wiring.

Promoting adequate wiring in its own columns is an old practice of EW. This month the practice will be extended to promoting it in paid monthly advertisements in three other publications: Business Week, Printers' Ink, and Industrial Marketing. Naturally the entire series will also run in this magazine. The advertisements will offer a free copy of "Getting the Most from Your Home's Electric System," published by the Adequate Wiring Bureau.

Electrical World has no illusion that this campaign will lead directly to adequate wiring in all homes of the country. For today there are over 20 million homes with inadequate wiring. But EW does believe in doing the best it can do. There never can be too many agencies promoting adequate wiring.

Here We Go Again

The minuscule corner is taking another pot-shot at power en masse. Only a few weeks ago it was the atomic battery of Ohmart and RCA. Now Bell Telephone Laboratories announces it can make power from the sun via the transistor. The atomic battery would have to be replenished after a while with nuclear fuel, but the solar battery should last as long as the sun lasts.

So far the solar battery has the edge of superiority over the atomic—it will last longer. Also it is reportedly a million times more effective in producing watts of useful electricity. Compared with power derived from the energy of the sun stored up in fossil fuels, it is nevertheless little of a threat to the established steam, and hydro-power, utility industry. That industry works around the clock rain or shine. It can generate a million kilowatts of steam power on 5 acres if necessary. Solar power waits on the convenience of the sun. It can, at present theoretical efficiency, produce 245-kw from an acre of transistors exposed to full sunlight. Or a householder living on a 50 x 100-ft lot and willing to live sunlessly under a large horizontal venetian-blind array of razor-blade-shaped transistors could dream of enough electricity on sunny days to operate a steam-flatiron. His investment? Maybe $3,000 in the solar canopy.

Youth Likes Science but not as a Career

America, the only land where six-year-olds shoot atomic ray guns and talk about space ships and where teen agers drive and assemble their own autos, is running short of scientists. While American youth is delighted to have the benefits of science, it is not too eager to make its own contributions.

Some readers may scoff at this and point to the great work done by members of the 4-H clubs and the results of Westinghouse's annual talent search. But these are only isolated instances involving comparatively few students.

The scorn of the young people for scientific careers has led the Future Scientists of America Foundation of the National Science Teachers Association to poll 425 science teachers to find out if they know the reasons.

The teachers have their ideas. They believe that the students don't know the importance of science in modern technology and the opportunities available in technical careers. They believe students should get more information about science activities, contests, scholarships; more first hand contact with scientists, engineers, and actual working conditions in laboratories and industry; and better equipped laboratories.

Teachers also blame student preference for easier courses which won't lower their grades, lack of communication between high school and college about science programs, and little emphasis on science experience by teachers in grade school.

The teachers also admitted their own shortcomings in enthusiasm and training. But they suggest remedies. They want summer jobs in engineering and scientific industries, workshops and institutes which will bring them up to date on what is happening in science, and additional college work which is taught with the high school science teachers' problems in mind.

If it only will, the electrical industry can do much to assist the teachers in remedying their shortcomings.

For Those Who Did and Did not Attend

This issue of Electrical World probably will be seen less promptly than any other issue published this year. The reason is that this week several thousand subscribers are at Atlantic City participating in the 22nd annual convention of the Edison Electric Institute. But this convention is so important to the industry that all readers will have a keen interest in everything that takes place there. To refresh the memories of those who were present and to inform those readers who were so unfortunate as not to have been able to attend, EW, following a long established practice, will devote its June 14 issue to the complete coverage of the convention program.

THE ELECTRICAL WEEK

The Issue's News Highlights . . . Atomic experts discuss relative merits of various nuclear power reactors at Washington, D. C., meeting.

EEI survey forecasts 19.2% power reserves for the country as a whole for December, 1954.

House Appropriations group is trying to sustain its own cuts in TVA budget which Senate later partially restored. . . . Rocky Mountain utilities attack preference clause at Hoover task force meeting.

Beirut (Lebanon) Electricity Co Pres M. George Granchamps has cabled the Lebanese Premier Abdulla El-Yafi informing him that the general assembly of shareholders in their meeting in Paris has agreed to sell the company to the Lebanese government for $12 million.

A hearing for an injunction against a rate reduction for customers of Georgia P&L will be held May 27. Fulton Superior Court Judge Virlyn Moore moved the date up from May 31 at the request of the Georgia PSC (See page 83).

Shawinigan W&P has been successful in making high-grade titanium metal by an electrolytic process. A larger pilot plant is being planned as a step toward commercial production.

Aerial surveys of Labrador's Hamilton River to study its hydro possibilities are planned by two Canadian firms. The river is said to have a potential of 10 million hp. Power is needed for the development of mining areas.

Central Illinois Public Service Co has received Illinois Commerce Commission approval to increase rates by $3,634,000 annually based on 1953 sales.

Union County PUD's proposal on the Oregon County's primary ballot asking authority to issue and sell $4.5 million in bonds to purchase California Pacific Utilities Co properties has been defeated by the voters. The unofficial vote tally listed 2,600 votes "no" and 2,209 votes "yes."

Threatened strike is averted at Public Service E&G as IBEW-AFL agreed to submit company's offer of a 3% package increase (wages and fringes) to a vote by the employees, without any recommendation for approval.

Clinton, Ky., City Council has rejected a Kentucky Utilities Co bid to furnish power for the Hickman County seat. Council said it planned to consider a plea by a group of citizens to work toward establishment of a municipally owned system. Council also heard arguments presented by a group of citizens favoring a KU franchise.

Off the Washington Wire . . . New draft of industrial atomic power legislation has been released by the Joint Congressional Committee on Atomic Energy. In ironing out the kinks in the earlier version, the committee has sought to clarify licensing procedures for nuclear power plants.

FPC has issued a license to Central Maine Power for a 76,600-kw hydro project on Kennebec River and a preliminary permit to Northern Lights, Inc, for a 9,000-hp project on Priest River in Idaho.

REA turned down a $950,000 loan of Central Power Cooperative of South Carolina, a transmission cooperative.

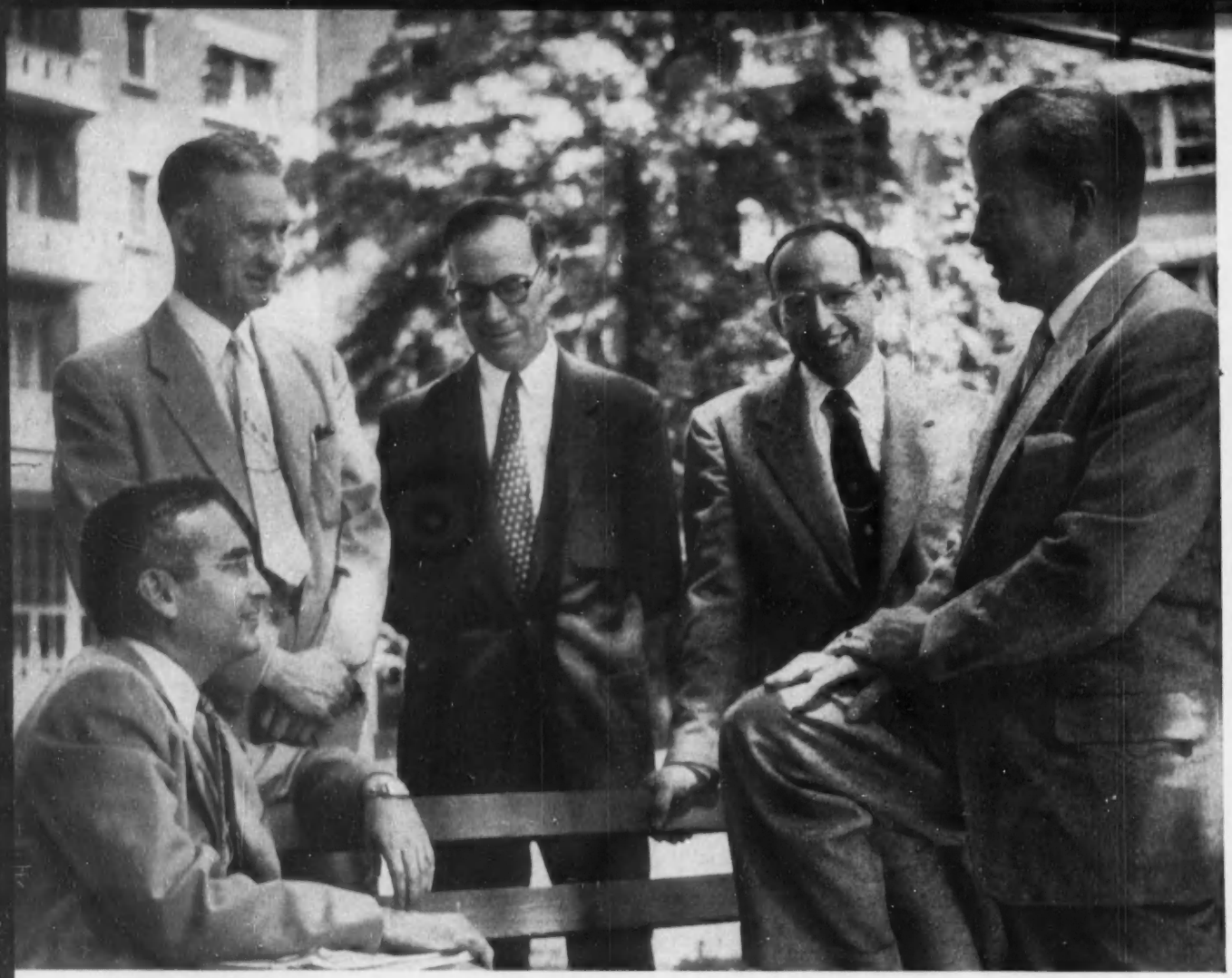
The House has passed bills authorizing joint local-federal financing of $360-million Priest Rapids project on the Columbia River and $34-million Cougar Power development on south fork of McKenzie River in Oregon. Legislation to authorize $320 million development at John Day site—was scheduled for introduction in both Houses of Congress as EW went to press.

Still on the Supreme Court's calendar was the appeal by The Lake Ontario Land Development & Beach Protection Association for the court to hear its case against FPC license granted to State Power Authority of New York for development of St. Lawrence power projects. Government has filed its opposing brief, asking quick denial of the appeal before court adjournment scheduled for June 7. Delay in considering case beyond that time, according to the government, would hold up construction start until next spring; but if the court acts promptly, N. Y. authority could get financing and construction of power project underway by July 1.

Two Columbia River power dams were voted larger fiscal 1955 funds in Senate version of civil functions money bill. Senate boosted House figures from $29 million to $38 million for The Dalles and from $27 million to $30 million for Chief Joseph.

A New York newspaper last week reported that Samuel B. Morris, general manager of Los Angeles Department of Water and Power, is being considered for the TVA chairmanship.

Executive Changes—Consolidated Edison Co of New York elected two vice presidents: Winthrop E. Mange for industrial relations, and Otto W. Manz, Jr, for testing and distribution . . . W. W. Lynch, president and general manager of Texas P&L, became board chairman to replace retiring John W. Carpenter. Charles W. Woolridge and L. A. Byron were made vice presidents . . . Edward Ruisch, assistant to the president of Iowa Public Service, was named vice president.



CHIEF PROTAGONISTS in reactor dispute are (l to r) Alvin Weinberg, Oakridge National Laboratory, who backs homogeneous reactor; Walter H. Zinn, Argonne National Laboratory, fast breeder and boiler water reactors; Lawrence Hafstad, director of AEC's Reactor Division; Chauncey Starr, North American Aviation, sodium-graphite reactor; and Charles Weaver, Westinghouse, pressurized water reactor

Atomic Experts Stage Reactor Debate

Battle lines are forming in the drive to achieve a competitive electric generating plant fired by nuclear fuel.

Electric companies and other industry groups spelled out their own positions at Atomic Industrial Forum meeting in Washington last week—lining up behind one or more of five basic atomic fireboxes (reactors) being developed under sponsorship of the Atomic Energy Commission.

In the background of this Washington meeting was the continuing legislative effort to relax the Atomic Energy Act to permit industrial development of atomic power. Hearings before the Joint Congressional Committee on Atomic Energy were temporarily in recess, but a new draft of the bill was scheduled to be released.

Government witnesses headed by AEC officials are to appear this week as the Congressional group seeks to wind up its present round of hearings.

GE Endorses Two Reactors . . . General Electric Co chose the forum meeting to announce its endorsement of two types of reactors which it believes will compete with coal-fired plants within the next five to ten years. Other participants at the forum meeting heralded the GE announcement as a drastic departure from its previous pessimistic views toward a commercial nuclear power industry.

Francis K. McCune, general manager of GE's Atomic Products Division, told a capacity audience at the forum meeting that GE had chosen the boiling water and the graphite-moderated water cooled reactors as the ones best suited for "earliest and most effective competition with conventional fuel plants in this country. . . ."

Figures presented by McCune (see tables) indicated both these reactors, if built in large enough plants, stand

a good chance of competing with conventional plants in higher cost fuel areas. The one problem that dominates the future of both these reactors, McCune said, is the development of a satisfactory fuel element. What GE is shooting at is the fabrication of nuclear fuel element good for 10,000 Mw days per ton of fuel. This is the equivalent to a fissioning of about 1% of the total atoms of all kinds of uranium. It would mean fissioning not only of the U235 present in the fresh element but also a conversion of the U238 atom to plutonium and subsequent fissioning of them.

Westinghouse Plugs PWR . . . Westinghouse Electric Corp, now engaged in building the first utility-scale nuclear power plant in this country, continued to plug for its pressurized water reactor. Charles Weaver, manager of Westinghouse's Atomic Power Division, said he believed engineering and mechanical problems can be licked to make PWR economical.

Westinghouse, which built two pressurized water reactors for submarine use, is charting new courses in its power reactor. Weaver named these features as unprecedented in the power reactor field: slight enrichment of the fuel, long core life span, deliberate intent to burn plutonium after it is generated through reactor operation, and the use of ordinary water in conjunction with other features. PWR, he said, will have these features.

Weaver laid down the first specific picture of the Duquesne Light Co's installation to be divulged. In brief, he said, the reactor core will consist of closely spaced fuel elements of enriched uranium in a geometrical pattern within a 6 ft cylinder 7.5 ft high. Maximum fuel element surface temperature will be less than 636F—boiling point of water at 2,000 psi. Maximum heat release will exceed 350,000 Btu/sq ft/hr and the average power density about 45 kw of heat per liter. The shell enclosing the reactor vessel will be of carbon steel, clad with stainless, 9 ft in diameter and 25 ft high, leaving ample room for experimentation with bigger cores.

The reactor vessel will be penetrated by inlet and outlet pipes of four coolant loops. At 60,000 kw output each loop will circulate 16,000 gpm of water at 2,000 psi propelled by 1,000 hydraulic horsepower. Each loop conveys heated water through the reactor and steam generator at an average temperature of 525F. The steam generator, which links the primary system and the steam system, comprises a water-to-water heat exchanger, steam drum and separator. It delivers saturated steam at 600 psia to the turbine-generator. Although there are four complete coolant loops provided, three suffice for 60,000 kw of electrical output. Shut-off valves isolated the fourth loop as required.

Weaver shared a panel discussion on reactor development with four other nuclear power experts who head the government's sponsored nuclear power program. Other panel members were Lawrence Hafstad, director of AEC's Reactor Division; Chauncey Starr, director of atomic research for North American Aviation, Inc; Alvin Weinberg, research director at the Oak Ridge National Laboratory; and Walter H. Zinn, director of the Argonne National Laboratory.

Hafstad dealt generally with the five reactor projects under AEC sponsorship. His calm, scientific approach served to bar any hot public debate among the chief protagonists of the leading reactor types.

General Electric Takes a Look at Nuclear Power Costs . . .

	Boiling Water Reactor (300 Mw)	Graphite Reactor (700 Mw)	Coal-fired Plant (300 Mw)
Costs (in mills per Kwhr)			
Fixed Charges	4.65	5.2	3.0
Operating Cost	.70	.6	.5
Fuel	1.35	1.0	3.4*
Totals	6.7	6.8	6.9

* Coal at 35¢ per million Btu.

GE Estimates Are Based on These Assumptions on . . .

	Fixed Charge Rates
Applied to Plant	
Yield on Investment	5.7%
Federal Income and State Tax	5.7%
Depreciation (25-Year Sinking Fund at 6% Interest)	1.8%
Liability Insurance	0.5%
Total to Plant	13.7%
Applied to Land	11.4%
Applied to Nuclear Fuel Inventory	9.6%

It did not, however, keep Weinberg from jabbing at the high steam costs of the Westinghouse PWR. Referring to the agreement under which Duquesne Light will purchase steam from the PWR, Weinberg said: "Poor Duquesne has to pay around 60¢ per million Btu" for steam output.

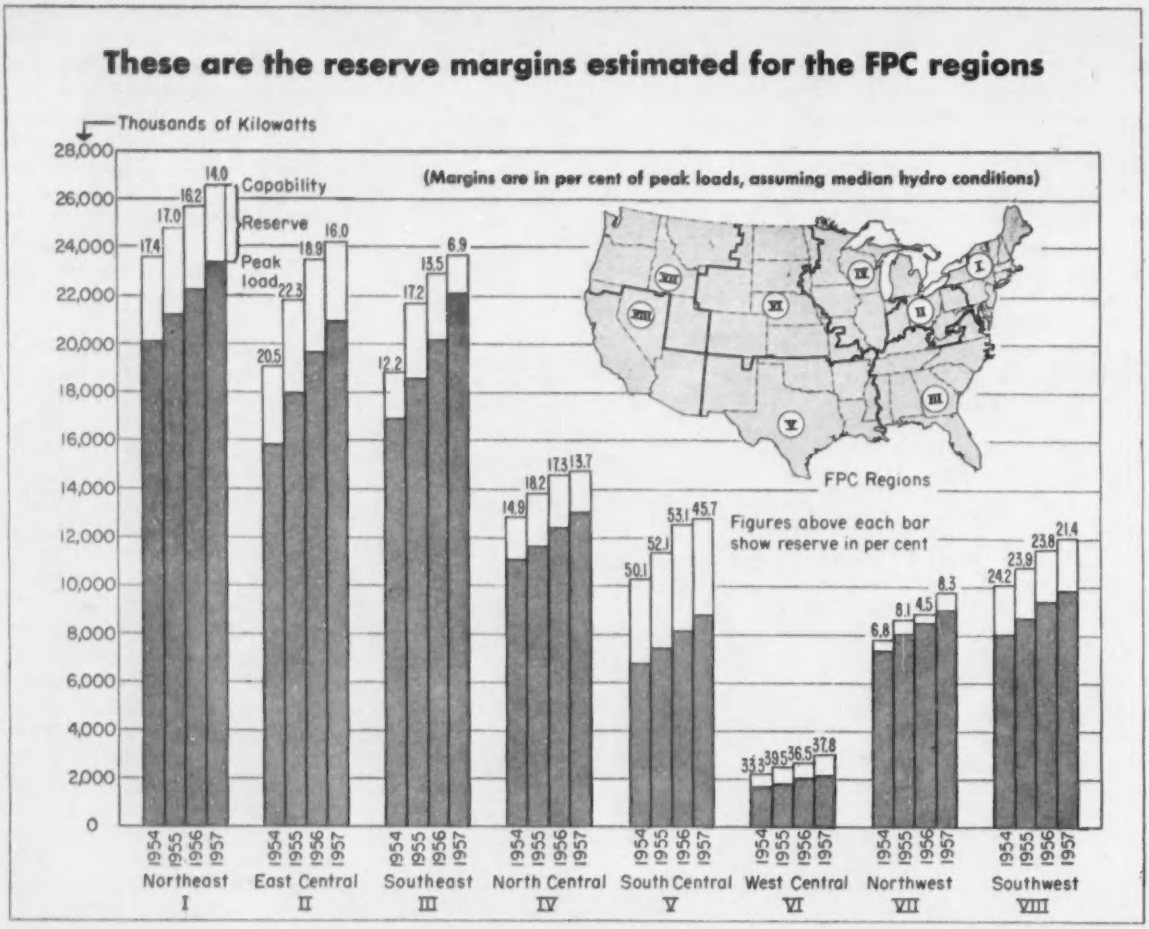
Weinberg, who heads the homogeneous reactor experiment at Oak Ridge noted that the fuel for this homogeneous reactor is carried in aqueous solution and may be reprocessed in a continuous cycle, whereas the other reactor types require solid fuel elements that must be withdrawn completely for reprocessing. Chief drawbacks to the homogeneous reactor, he said, are the relatively low temperatures possible, the leak-proof fuel circuit, and the "wicked" corrosion problems of the fuel circuit.

Starr gave a resume of the sodium-graphite experimental reactor which North American Aviation is building in partnership with AEC. High temperatures and the possibility of becoming a self-sustaining breeder were listed among the assets for this type.

Dr Zinn described the boiling water experimental reactor and the fast neutron breeder reactor, both being developed at Argonne. An experimental model of the boiling water reactor can be constructed much more rapidly than the breeder reactor, Zinn said.

C. R. Barthelemy, project engineer of the Pioneer Service-Foster Wheeler atomic power project, said his group had dropped its study of a fluidized solid moderated and cooled reactor when it indicated a lack of operating stability. This group is now engaged on an economic feasibility study of an aqueous, homogeneous breeder reactor. Purpose is to design a reactor for use by the power industry.

Five-Company Study . . . Study of the five-company electric utility group was outlined by Titus LeClair, chairman of the operating committee. A study of a heavy water reactor by that group indicates the long range possibility of 7 mill per kwhr power from such a reactor, but the cost of heavy water would be the determining factor. This group also is looking at the boiling water reactor and the homogeneous reactor. This electric company group consists of American Gas & Electric Service Corp, Bechtel Corp, Commonwealth Edison Co, Pacific Gas & Electric Co, and Union Electric Co of Missouri.



EEI Predicts 19.2% Reserve for 1954

The margin of capability over peak load for the country as a whole at the end of December of this year will be 19.2%, according to Edison Electric Institute's 15th Semi-Annual Power Survey released this week. The figure compares with 17.5% for December 1953 and an estimated 21.3% for 1955.

The 1954 reserve margin is based on capability of 105,440,000 kw and peak load of 88,424,000 kw; margin for 1955 results from estimated capability of 116,378,000 kw and peak load of 95,978,000.

In December 1956 margin for the nation as a whole is expected to decline slightly to 19.4% with capability at 122,814,000 kw and peak load at 102,875,000 kw. A further drop in reserve is predicted for 1957 when the margin will be 16.2% with capability at 127,336,000 kw and peak load at 109,627,000 kw.

EEI's estimates assume median hydro conditions and should they prevail no section of the country would experience power shortages over the next three or four years.

But in the event of adverse hydro conditions the Pacific Northwest would be in trouble for the period 1954-57.

In case of low water conditions the western division of Federal Power Commission Region VII is expected to have power deficits at the end of 1954 of 7.4% and of 6.7% at close of 1955. Should adverse hydro conditions continue the deficit would grow to 9.8% at the end of 1956 and then drop to 7.1% for 1957.

Still assuming adverse hydro conditions, the EEI report estimates the eastern division of Region VII would have these reserves: 1954, 13.9%; 1955, 14.2%; 1956, 8.2%; and 1957, 20.8%. But these margins are not enough to eliminate deficits for Region VII as a whole: 1954, 3.7%; 1955, 3.2%; 1956, 6.85%; and 1957, 2.5%.

Continuing a recently established trend, peak load for Region V will occur during the summer, the EEI survey indicates. Although region reserve is listed as 50.1% for December 1954, 52.1% for 1955, 52.1% for 1956, and 45.7% for 1957, summer reserves are less than half these percentages. Margins for the summer months are estimated as follows 1954, 22.3%; 1955, 23.9%; 1956, 24.1%; and 1957, 17.0%.

Coosa River Bill . . .

. . . permitting five-dam development by Alabama unopposed at House committee hearing

Legislation to permit a privately owned power company develop the Coosa River in Alabama was set to clear its first Congressional hurdle last week.

Not a single opposition witness appeared during the one-day round of hearings on the bill before the House Public Works Committee earlier in the month. Backing the measure are both the Alabama Senators and eight of the nine-member Alabama House delegation. Further support for the bill comes from the Army Corps of Engineers and the Federal Power Commission.

$100-Million Project . . . The bill would clear the way for the Alabama Power Co to build a $100-million, five-dam power development on the Coosa River. There would be initially 321,000 hp of installed capacity and ultimately 482,000 hp of installed capacity.

Alabama Power filed an application with FPC in November of last year for a preliminary permit for the development. However, after conferences with FPC attorneys and other government officials, it was determined that additional legislation would be needed to permit private development of the stream. The project had been generally authorized for federal development by a 1945 law, and one of the five dams had been specifically authorized.

The pending legislation would suspend any existing authorization for power development.

Bill Proposing Payments by U. S. Projects Debated

Legislation which would subject federal water power projects to payment of upstream benefits derived from private developments was scheduled to receive its first hearing before the Senate Interstate and Foreign Commerce Committee sometime last week.

Bill for the legislation was introduced by Sen John Bricker (R-Ohio), at the request of the Federal Power Commission. It followed a request by President Eisenhower for consideration of such a measure.

Several government officials were asked to appear at the hearing and private company spokesmen were invited. Should the bill draw strong opposition from any quarter it would likely be put over until the next session of Congress.

Michael Straus Testifies At Hells Canyon Hearing

Former Reclamation Commissioner Michael W. Straus returned to the public eye last week on the side of federal power. He testified at the Hells Canyon hearings before the Federal Power Commission and made the claim that the Bureau of Reclamation has the greatest experience and knowledge in the world in building dams, for the necessities of today.

"As far as I know," he said, "the bureau has never lost a dam or had a failure in its history."

In this way, Straus came out for the federal high dam at Hells Canyon. His testimony covered the general evolution and policies underlying the Hells Canyon project as proposed by the Department of Interior under the Democratic Administration.

Straus said that in a letter to President Truman on April 11, 1949, he laid out two plans that were fully coordinated and contained the policies for work to be done on Columbia River basin projects. These plans were designed to meet the future needs of this area which includes Hells Canyon. In a letter he advised that Reclamation develop Hells Canyon as soon as possible.

He indicated that Idaho Power Co did not file a preliminary license application for a low dam at the Oxbow site on the Snake River until after publication of the government report. Straus said he had no knowledge of any private company that could make a report like the one that he made in 1949.

He said his report used the experience of government and non-government agencies, among which were the Army Corps of Engineers, Weather Bureau, Geological Survey, and many others.

Evan M. Weston, president of the Washington State Federation of Labor, AFL, testified the development of abundant, low-cost hydroelectric power would encourage new enterprises and expansion of existing enterprises which can contribute to the steady growth of employment and payrolls throughout the entire Pacific Northwest.

AP&L 'Rose Trellis' a Thorn to Ladies

The floral battle flags shown above were erected by Little Rock residents who are fighting Arkansas Power & Light Co's new high voltage line running through their residential area. When Arkansas P&L's workmen arrived to put up the pole (pictured above) the housewives refused to budge from perches on a crossbar of the power pole. The women claim they'll sleep over the pole holes to stop pole setting. AP&L, however, says work has not been held up.

TVA Funds Fight

House committee seeks to sustain cuts in agency's budget partially restored by Senate

A tight-fisted House Appropriations subcommittee has a few tricks up its sleeve to sustain its own deep cuts in the Tennessee Valley Authority budget for the next fiscal year.

It wants to keep appropriations for the agency to $103.6 million. That's the amount originally set by the subcommittee and approved by the House for TVA during the coming fiscal year. It is $38 million less than requested by the President for that purpose in his budget message.

The Senate recently boosted the TVA figure to $129.6—$26 million above House-approved figure.

No New Plants . . . Neither the House nor Senate versions would provide funds for new generating facilities except for those already under construction. The House would allow TVA to dip into its corporate fund for some $37 million of its system improvements and additions and reserve for contingencies.

Normally House and Senate conferees could be counted on to split the difference between the two figures—thus giving TVA about $116.6 million for the coming year. Or if the Senators were particularly adamant, the conference group might even agree to give TVA the full $129.6 million voted by the Senate.

But this time the House Appropriations subcommittee has been doing a little outside work to head off the usual Senate increase.

Check on TVA Accounts . . . Two House subcommittee auditors and a lawyer have been checking over TVA accounts—particularly the corporate fund which TVA uses for operating expenditures. Word leaked out last week that the subcommittee investigators had found some questionable figures there. There was the hint that a retirement account for TVA employees might be oversubscribed by as much as $8 million. There were other things turned up by the investigators which House members thought might come in handy when the conference committee showdown came.

One committee member told Electrical World: "We believe we have plenty of evidence to sustain our case for the lower appropriation."

Senate Action . . . The Senate had practiced a little thrift on its own regarding TVA funds.

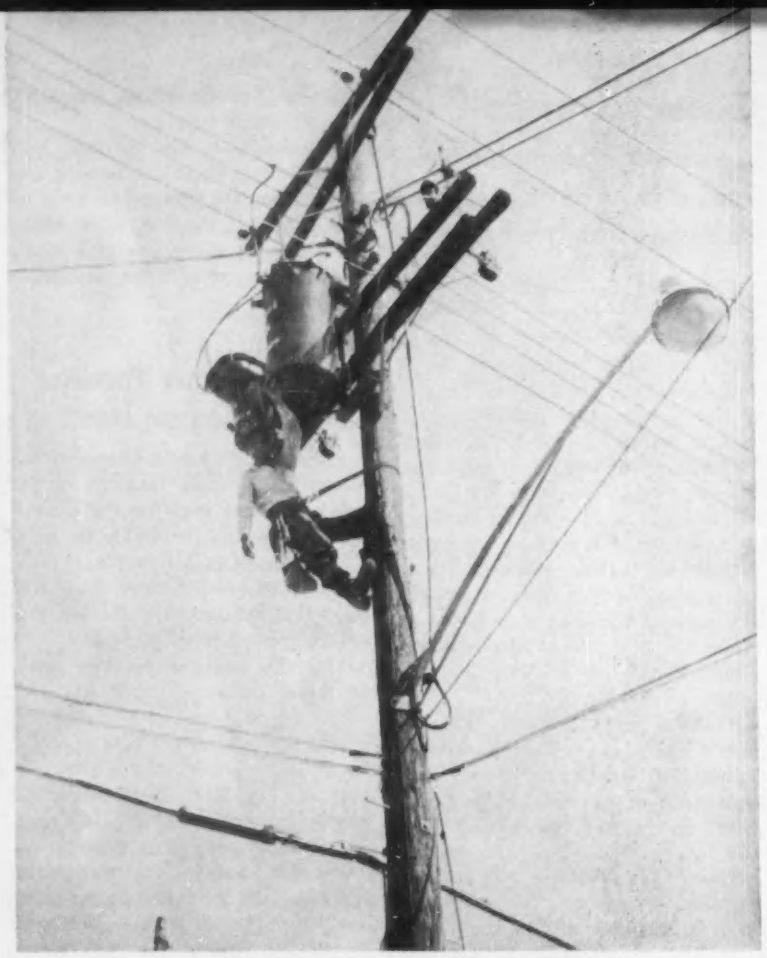
During floor debate it rejected these amendments:

- One offered by Sen Estes Kefauver (D.-Tenn.) which would have raised the appropriations by $30 million to provide funds for hotly disputed 450,000-kw Fulton plant.
- One offered by Sen John Sherman (R.-Ky.). Cooper which would have tacked a $12 million increase on the Senate bill to bring it in line with President Eisenhower's budget request for the agency.

No changes were made by the Senate in other parts of the bill providing funds for Atomic Energy Commission, Federal Power Commission, and Securities and Exchange Commission.

Without debate it voted the amounts recommended by the Senate Appropriations Committee for these agencies. (EW, May 24, p 8).

In a related development, the bureau of the budget said it hoped to decide by June 10 whether it would accept outside offers to supply power to TVA loads. Two proposals have been made to supply power in the TVA area—one by Southern Co and Middle South Utilities and one by a syndicate represented by Memphis attorney Lucius Burch.



Peter at the Dike—Well Almost

When Florida Power & Light Co Troubleman A. N. Dreggors (on pole) arrived at the scene of a leaky transformer in Daytona Beach early this month, his memory harked back to the time-honored story about the little Dutch boy who saved his village from being flooded by plugging a leak in the dike with his finger. Finding himself in a somewhat similar position as Peter, the Dutch boy, Dreggors placed the palm of his hand over the leak until help arrived and a temporary wooden plug could be installed to check the leak.

Utilities Hit Preference Clause

Private companies tell Hoover task force preferential treatment for public groups discriminates against most users

Widely divergent views of private utilities and rural electric cooperatives were restated by their spokesmen at Denver hearings (May 17-19) before Hoover Commission's task force on water resources and power.

The task force, headed by Adm. Ben Moreell (ret) is investigating work of federal agencies in reclamation, power development and flood control.

Private utility leaders concentrated their attack on the preference clause which gives first call on public power from reclamation works to REA co-ops and municipal systems.

E. M. Naughton of Salt Lake City, presenting arguments for 21 private utilities in eight mountain states, declared the preference clause "discriminates against the vast majority of electric users (served by private utilities) and relegates them to the position of second-class citizens."

J. E. Corette, president of the Montana Power Co, called the preference clause "one of the most serious inequities" in U. S. law. He also charged the Bureau of Reclamation was "building great monuments" to develop a power empire while neglecting Montana's irrigation needs.

Naughton said the utilities favor "some factor" to equalize private and public power rates. He said federal projects should pay the same state and local taxes utilities pay and that federal taxes should be considered in project planning and cost allocation.

The spokesman for the private electric companies declared that in connection with construction of justifiable federal multipurpose projects, local power producers and distributors should be permitted to:

"1. Build the powerhouse and generating facilities, pay taxes on those facilities, and pay for the use of the dam and falling water, or

2. Lease the generating facilities at projects where the construction of such facilities by local distributors is not feasible, or

3. Purchase the electricity at the powerhouse under long-term contracts without discrimination.

McNaughton also stated that wherever feasible, the transmission facilities necessary to carry the power to load centers should be built by local distributors without burden on the taxpayer.

REA leaders from Oklahoma, the Dakotas, Kansas, Texas, Iowa, and Colorado bitterly opposed the utilities' proposal. The spokesmen, who said they represented 221 co-ops serving 1.5 million farm families, claimed the utilities' offer would mean that rural electrics and municipal utilities would have to pay higher power rate profit tolls to a private "middleman" and would face extinction.

Leo Forest, president of the Texas Electric Cooperatives, Inc, said "our needs are continually outstripping our forecasts . . . we urge you to give careful consideration to the maximum that can be done by the federal government. . . ."

Reclamation, Corps OK 4 Middle Snake Dams

Four multipurpose dams with more than 1.4 million kw of installed capacity on Middle Snake River and tributaries were endorsed last week in a joint report by Army Chief of Engineers and Commissioner of Reclamation. Report was sent to Columbia Basin states and federal agencies before being submitted to Congress.

Projects endorsed for possible corps development were at Bruces Eddy and Penny Cliffs on Clearwater River. They would have 532,000-kw capacity and cost $320 million.

Details of proposed project, on Snake depend on Hells Canyon decision. If Idaho Power Co's three-dam plan is adopted, Reclamation proposes 630,000-kw project at Pleasant Valley for $202 million and 250,000 kw at Mountain Sheep for $99 million. If one high dam is built plan calls for 720,000-kw and 300,000-kw projects at cost of $219 million and $110 million.

Ewing Named Aide to Pearl

Appointment of Paul F. Ewing, special assignment reporter on power, reclamation and irrigation developments for the "Portland Oregonian," to a position of special assistant to the administrator of the Bonneville Power Administration has been confirmed by Secretary of the Interior Douglas McKay.

Ewing, 42 and a native of Oregon, was expected to transfer to his new job immediately. His work will be to head up the information and public relations services. But it was understood at Bonneville he may take on some responsibilities delegated to the late Harry M. Kenin, executive secretary who resigned in February, and Henry Alderman, another ex-newspaperman who resigned as of May 21 as assistant to the administrator in field operations. The job is outside civil service protection and carries a $9,600 starting salary.

Whether Ewing may later be moved up to one of the new Interior Department positions recommended by a survey team for the department's informational services was uncertain. The team had proposed three such offices, for Portland, Denver and Anchorage,

PAUL F. EWING

and these were confirmed by McKay as in the works.

Ewing has had wide journalism experience. Upon graduation from the University of Oregon in 1934 he worked at Turlock, Calif., and for the "Oakland Tribune," Oakland, Calif., "Spokane Chronicle," Spokane, Wash., the "Seattle Star" as city editor, for the Associated Press in the Portland bureau, and for "The Oregonian."

LOADING IS SCHEDULED from a modern system dispatching office set up in 1949 in the company's general office building in Amarillo

Loading Plan Saves $50,000 a Year

Southwestern PS adopts program giving careful consideration of incremental costs of fuel and transmission losses, and size and location of system loads

G. W. DUPREE, System Planning Engineer,

J. ALTON MILLER, Supt, System Production and Operation, Southwestern Public Service Co, Amarillo, Texas

L. K. KIRCHMAYER, General Electric Co, Schenectady, N. Y.

Estimated savings of from $50,000 to $60,000 per year in direct operating costs have been realized from Southwestern Public Service Co's economy loading program. Other substantial benefits of the program have been the better evaluation of plant performance, machine down time for overhaul, line clearances, and system bottlenecks. This specific, comprehensive program has stimulated operators, dispatchers, and other personnel to strive for the best possible operation.

The company serves approximately 45,000 sq miles in the regions generally known as the the Oklahoma Panhandle, Texas Panhandle, South Plains of Texas, and the Pecos Valley in New Mexico. The basic system comprises 610 miles of 115-kv transmission line and 1,325 miles of 66-kv transmission line connecting 11 steam power plants. These plants have a total capability of 533,300 kw and vary in size from 6,000 kw at Guymon, Okla., to 165,000 kw at Plant X. The heat rate varies from 22,000 Btu per net kwhr at Jowett Plant to 11,000 Btu per net kwhr at Plant X.

Reasons for Study . . . In 1949 the system dispatching office as it now exists was put into operation, and the problem of economic scheduling of generation on a system wide basis began to receive attention. Before that time, the problem was greatly simplified by the fact that fuel costs varied widely between plants and the heat rates of machines within the plants were quite different. This made possible a scheme of classifying machines and plants according to their average fuel cost per kwhr and assigning loads according to this schedule up to the limits established by the transmission system.

Since 1949, the system has expanded very rapidily. The increasing number of modern machines having comparable heat rates made this method of assigning generation by classification less and less accurate. Improvement was achieved by the use of incremental fuel and cooling water cost schedules for loading machines within each plant. About the same time, the differences in fuel costs between plants were decreasing, and the transmission system had been expanded, permitting larger amounts of power to be transferred between areas. Increasing operating costs and greatly increased construction costs dictated that the best possible use be made of all of facilities. Hence, it was decided in early 1952 to complete incremental cost data and to make a detailed study of loading methods

in order to determine the value of improvements which could be made and the cost of further refining these loading procedures.

Application and Evaluation . . . In order to place a dollar value on possible improvements, comparisons were made between total daily fuel and cooling water costs, produced by loading methods then in use, and the daily fuel and cooling water costs that would be produced by loading all generating equipment by incremental plant cost methods.

As an example of the results in this study, it was found that during one typical fall day, the system could save $600 by loading all machines to equal incremental plant costs. Transmission bottlenecks would not permit this loading, but it was found that $125 could be saved by loading to equal incremental plant costs to the extent possible considering all transmission bottlenecks. Moreover, there was a possibility of eliminating bottlenecks accounting for $300 of the possible saving.

These studies indicated that potential savings of $70,000 per year could be realized by improving loading procedures. It was also shown that equal incremental cost loading of plants would produce surprisingly large changes in transmission line loadings and that the resulting changes in line losses must be considered if the maximum benefit possible from incremental cost loading was to be realized.

In view of these savings and problems, it was decided that the study would be extended to take into account the effect of line losses. As incremental cost data was developed for each plant, loading schedules were refined to consider that data to whatever extent was possible. Shortly after the incremental cost studies for the plants were completed, the system was being loaded by incremental fuel and water costs modified by our best judgment as to the effect of transmission losses. This does not mean that we were able to actually load all plants to equal incremental costs of delivered power that this was being approached as closely as limitations would permit.

The line loss portion of this study was made in Schenectady in January of 1953. From this study it was determined that consideration of transmission line losses would effect a saving of $14,000 per year on this system over equal incremental plant costs loading. Data secured in this study was used to develop new incremental cost of delivered-power curves. These curves then formed the basis for load schedules which are used by the dispatcher in the hour-to-hour assigning of load to power plants.

SYSTEM EXTENDS over portions of three states and an area equal in area to Pennsylvania and Rhode Island. System capacity is now 533 Mw

Assign Loading Schedules . . . The problem of supplying the dispatcher with loading schedules is the most difficult part of the operation. The entire program is either good or bad depending on how well these loading schedules recognize existing system conditions, such as, machine outages, minimum fuel requirements, and transmission limitations. In practice, it has been possible to hold actual generation very close to that scheduled for each condition of system load.

The use of generation schedules covering expected loads is not so flexible a scheme as we would like because they are awkward to use and require constant revision. However, we have been pleased with the results to date. After more experience and with a better file of data on the various system conditions we encountered in day-to-day operation, it is believed that the revision and actual use of the schedules will be much easier and less time consuming.

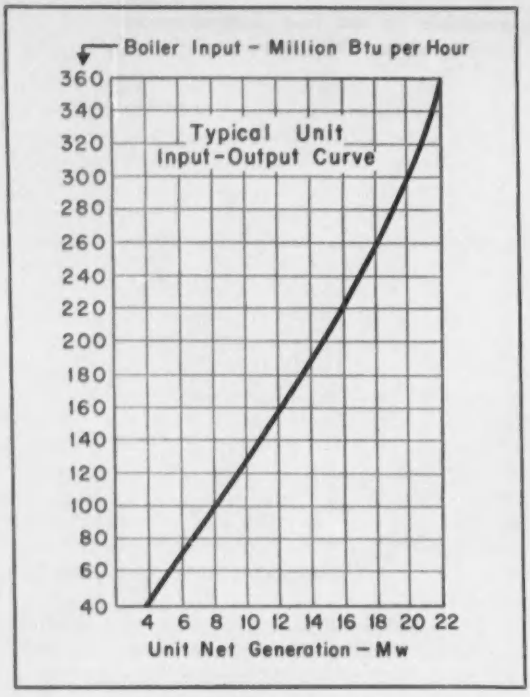
In addition to use of incremental cost scheduling in day-to-day system loading, the information from this study is being used to determine the cost of "down time" on machines for inspection and overhaul, and for evaluating differences in operating efficiency and capability due to turbine condition, condenser fouling, and other things.

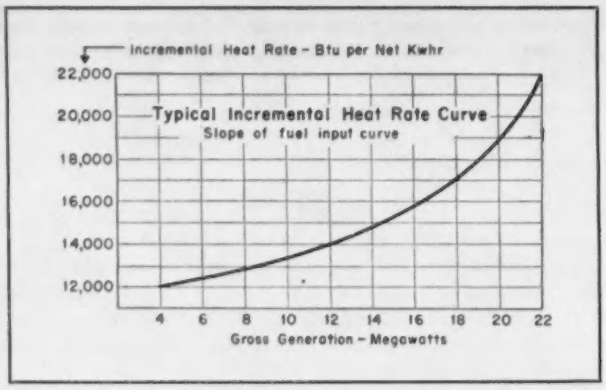
Cost and Savings . . . Application of incremental cost studies to actual dispatching of load has not increased the cost of dispatching but has increased the dispatchers' attention to details of operation and his efficiency by furnishing him with better information. In addition to the time devoted to this project by regular plant and dispatching crews, this program has occupied less than the full time of one engineer and so has not been a burden to the staff. In fact, the knowledge gained by the engineers in making this study has increased their efficiency.

Total expense directly chargeable to the Economic Generation Program has been less than $15,000 for 1953. For this investment we have saved between $50,000 and $60,000 in fuel and water costs. It is believed that the program will result in greater savings in the future by producing a better rounded program of operation, testing, and maintenance, in addition to the saving which will be made in fuel and water costs.

Summary of Procedure . . . Losses in the transmission network were expressed in terms of all source loadings by means of a transmission loss formula. If the next increment of system load is taken up at plant 1, the incremental transmission loss at plant 1 may then be calculated from a total loss formula.

If all plants were at the same location, optimum economy





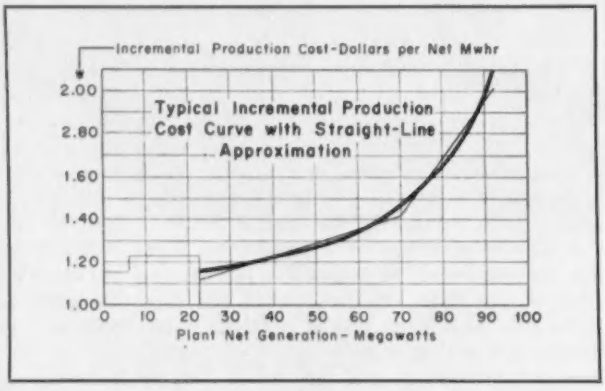


FIG 1—INPUT-OUTPUT DATA, such as these, were required for all units—FIG 2, upper right, incremental heat rate is a plot of slope of curve of Fig 1—FIG 3, right, incremental production costs with straight-line approximation were set up for plants based on assumed fuel costs

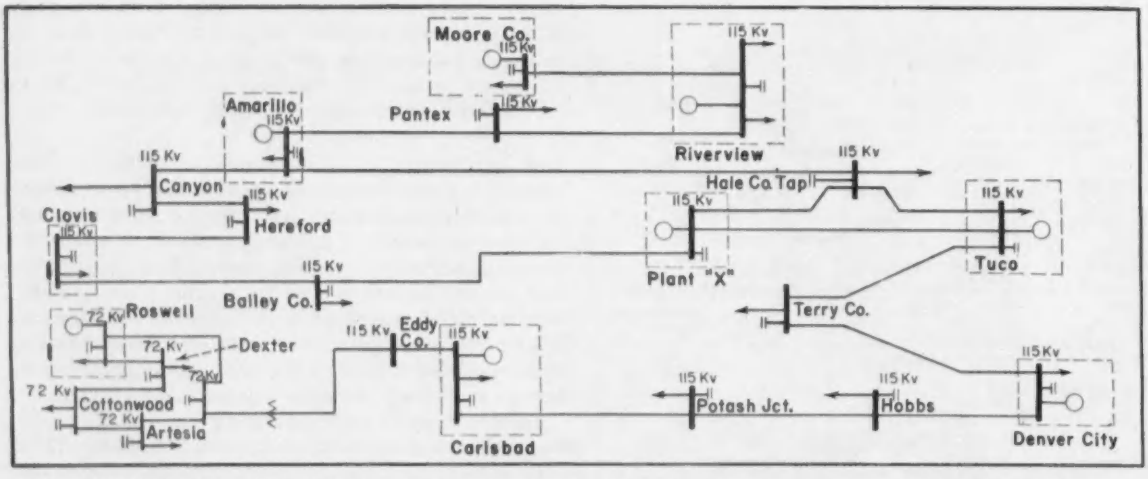


FIG 4—IMPEDANCES OF TRANSMISSION and sub transmission circuits and circuit arrangements were important in calculating losses

would be obtained when all units are operating at the same incremental production cost. As all the plants are not at the same location, transmission losses will occur in system operation. It is necessary to take these line losses into account. Methods of coordinating incremental transmission losses and incremental production costs have been developed, based upon the use of the transmission loss formula. Essentially this loss formula is used to calculate penalty factors which modify the plant incremental production cost to include properly the effects of transmission losses.

The resulting coordination equations can be solved on various analogue and digital computers. In order to do this, certain data are required, and a systematic procedure is followed in the analysis of the economic scheduling of generation.

Preparation of Data . . . Plant data required include:

1. Thermal performance of various units. Input-output data similar to Fig 1 was required for all units. The incremental fuel rate curve of Fig 2 is a plot of the slope of the fuel input curve of Fig 1.

Dispatching Chart Showing Plant Loads for Range of System Loads

GENERATION SCHEDULE FOR AUGUST, 1953

Capability Max	Capability Min	System	480	465	450	435	420	405	390	375	360	345	330	315	300	285	270	255
507	481																	
28	28	Roswell	28	28	27	27	25	25	24	23	22	21	20	19	18	16	15	13
46	46	Carlsbad	45	43	39	33	29	25	22	19	19	19	19	19	19	19	19	19
41	41	Denver City	41	41	41	41	41	41	41	41	41	41	41	41	41	41	40	39
42	34	Tuco	40	36	33	31	28	25	17	16	15	15	15	15	15	15	15	15
157	157	Plant X	157	156	156	152	151	149	148	142	135	125	112	101	90	80	70	60
80	68	East Plant	80	79	78	78	76	75	73	69	64	61	60	58	56	53	50	49
67	61	Riverview	51	44	39	36	33	29	29	29	29	29	29	29	29	29	29	29
28	28	Moore County	28	28	27	27	27	26	26	26	25	24	24	23	22	22	22	21
6	6	Guymon	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
6	6	Jowett	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
6	6	Clovis	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
226	27	Spinning Reserve	27	42	57	72	87	96	103	112	121	136	151	166	181	196	211	226

Not Available:
- Rv. T2 Idle
- Tu. T2 Idle
- Am. T1 Idle
- Am. T2 Idle

All Units Available

Note: Frequency Control Underlined

2. Incremental production cost characteristics of units and plants. The incremental fuel rate was converted to incremental fuel cost by multiplying the incremental fuel rate in Btu/kwhr by the fuel cost in cents per million Btu. The incremental fuel cost is expressed in $/Mwhr. The incremental production cost of a given unit is made up of incremental fuel cost plus the incremental cost of water. Other production costs remained fixed with load.

3. Straight-line approximation of incremental plant production costs. Straight-line equations of the incremental plant production costs such as indicated in Fig 3 were required for all plants.

Electrical system data required are:

1. Impedance diagram of transmission and sub-transmission facilities whose losses are dependent upon the manner in which generation is scheduled, Fig 4.

2. Load duration curve for period of operation to be considered. This curve is required in the determination of the annual differences in fuel costs resulting from different scheduling methods.

3. Selection of base-case loading periods and tabulations of loads, voltages, and probable generation schedules and interconnection flows.

In the derivation of the loss formula, it was assumed that each load remained a fixed percentage of the total load. During the summer a large percentage of the load is irrigation pumping load which is located in the southern part of the system. The winter loads are more evenly spread over the system and are to a large extent residential, commercial, and industrial in nature. These two widely different conditions required that each season be studied separately. Also large loads that do not vary with the rest of the system load during the daily load cycle require special consideration. On the Southwestern Public Service system two large industrial loads that remained practically constant during the daily load cycle were carried as negative generators with constant load.

Determine Loss Formula . . . Using the network analyzer resistance, measurements were made on the open-circuited transmission network. Normal load flow data were then obtained. This included generator voltage magnitudes, megawatts, megavars, angles, and scalar values of all line currents.

With the network-analyzer reference chosen so that the summation of the currents of the generators included in the loss formula equals a real number, the equivalent load currents were recorded. The equivalent load current at a bus is defined as the sum of the synchronous condenser, line-charging, and load current at that bus. For a check on the system operation load voltages, load and line megawatts and megavars, and synchronous-condenser megavars were recorded.

Data were then transcribed to punched cards. Loss formula coefficients were calculated on a card programmed calculator.

Calculate Savings . . . Savings to be obtained by considering transmission losses in the scheduling of generation were evaluated by determining:

1. Generation schedules by equal incremental production costs.

2. Generation schedules by solving coordination equations.

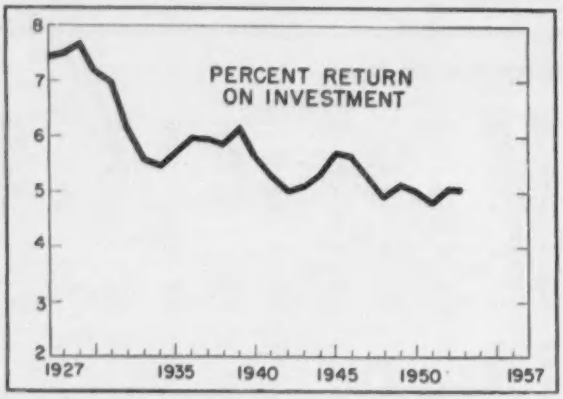
3. Cost of received power for each scheduled.

4. Difference in cost of received power.

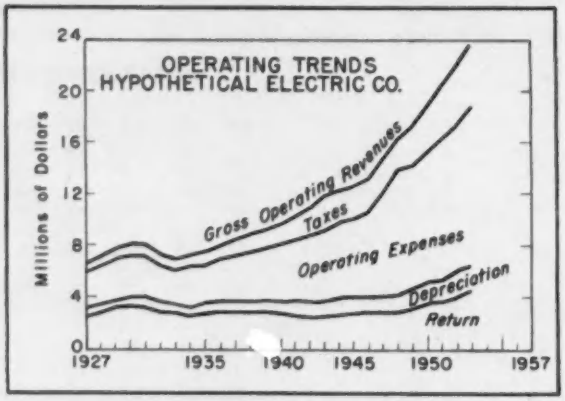
5. Annual savings through use of load duration curve.

Method Works . . . For hour-by-hour dispatching of generation, loading charts similar to the one above are used. These indicate each plant load for given system loads in 10 to 15 Mw intervals of system load.

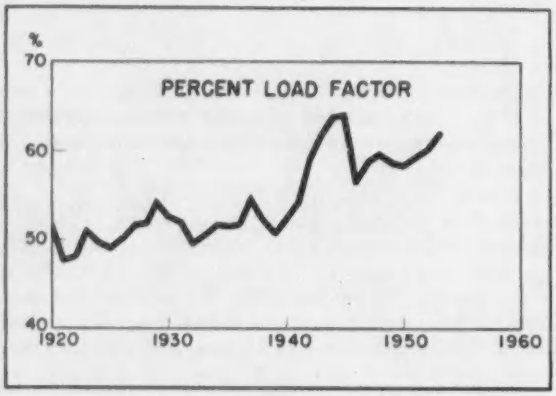
From these considerations the reasons, value, and methods used in a study of the economy of including transmission losses in generating schedules for an operating power system can be seen. The methods are being continually revised to obtain more accurate data at a lower cost. Other methods are being studied and compared to obtain the best solution to this important system problem.



1 Per cent return on investment was less in 1952 than it was in 1945 although industry sales just about doubled in that time



2 Operating trends of a hypothetical company show that revenues trebled from 1933 to '52, but return stayed level 1933 to '48



5 Load factor rose to 64% during World War II when factories were working three shifts. The load factor is about 60% now

ELECTRIC COMPANY
COST OF CAPITAL

TYPICAL CAPITAL STRUCTURE

	Average Proportion of Capital	Est. Cur. Yield Cost of Financing	Weighted Yield Cost
Long-Term Debt	50%	3.55%	1.78%
Preferred Stock	15	4.85	.73
Common Stock	35	10.00	3.50
	100%		6.01%

6 Cost of capital of a typical electric utility company indicates the minimum that it should be required to earn on investment

What Per Cent Return Is Electric

EDWIN VENNARD,
President, Middle West Service Co, Chicago, Ill.

The basic index of operation of the electric utility business is the return on investment shown on Chart 1. Return is the balance available for bond interest, preferred and common dividends, and surplus, divided by gross plant account. Every company should be expected, and required, to earn at least the bare cost of money in the open market.

During the early 1930's, and again in the early 40's, there was a decline in the return on investment. In the 30's the cause was the depression. In the 40's there was a general decrease in the cost of money so there was no great concern over the decline in the return on electric utility investments.

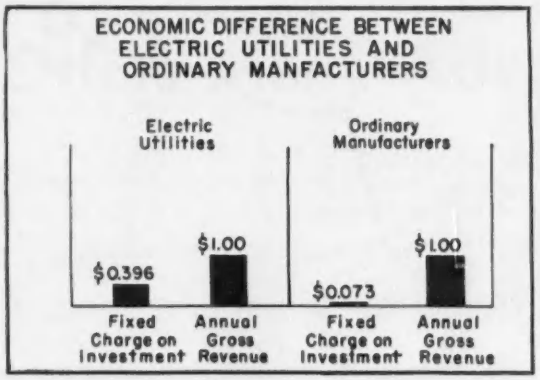
From 1945 through 1952 there has been another general decline in return on electric utility investments although sales in the same period have about doubled. But there has not been corresponding decline in cost of money.

Without a decline in the cost of money there is reason for some concern over this latest downward trend in return on investments. And, already, steps are being taken to change the trend.

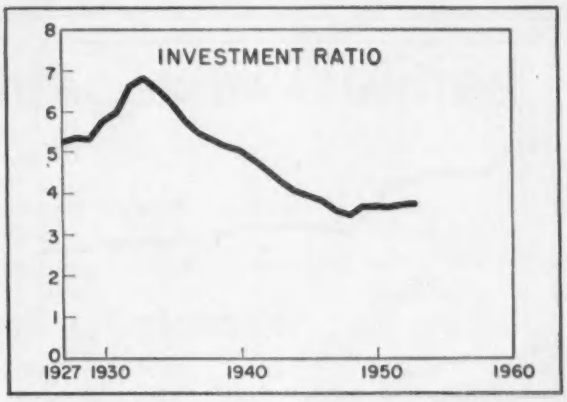
Statistics supplied by Edison Electric Institute and the Federal Power Commission have been divided by 300 to arrive at a typical average electric company.

Operating trends of this hypothetical company, Chart 2, show that gross revenues have about trebled from 1933 to 1952. But, balance for return on investment remained about level from 1933 through 1948. This failure to increase return on investment, while gross revenues were rising so rapidly, was caused by decreased rates and increases in taxes and uncontrollable expenses.

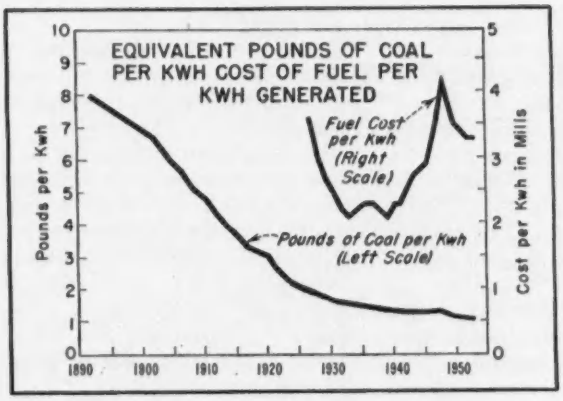
Our hypothetical company pays 24¢ of each dollar of gross revenue in



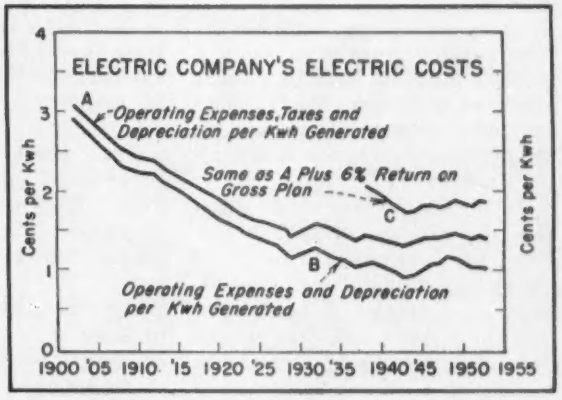
3 Fixed charges on investment per dollar of gross annual revenue are $0.396 for electric utilities, only $0.073 for manufacturers



4 Investment ratio was about $7 of investment for each dollar of gross operating revenue in 1932. Today it is $3.75 for each $1



7 Cost of fuel is in general rising steadily. Improved plant efficiences have been unable to counteract rise which is continuing



8 Cost of electricity to companies shows the effect of the increased uncontrollable expenses and investment costs since 1944

Utility Companies Earning?

taxes. This is the largest single item of expense.

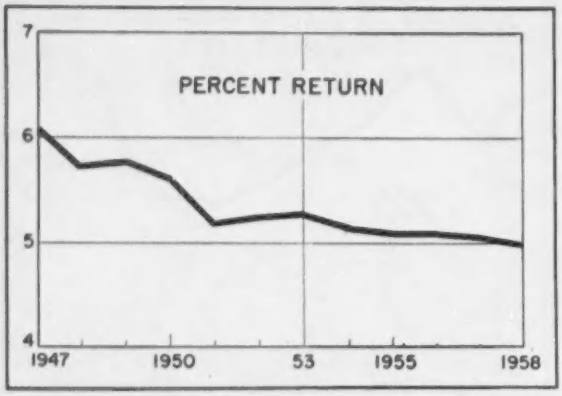
In order to earn a 6% return, 21¢ of each dollar of gross revenue would be used to pay bond interest and dividends on stock and provide surplus funds. The company actually earned less. Total fixed charges would amount to 57% of gross revenues. These cover insurance, depreciation, taxes, and return on investment.

A comparison of fixed charges for electric companies with those for an ordinary manufacturing company shows that the former paid 40¢ as fixed charges on investment compared to 7¢ for the ordinary manufacturer, Chart 3. The explanation for this difference is found in the fact that electric utilities have about $4 of investment for each dollar of annual gross revenue while manufacturers have only 34¢ of investment for each dollar of annual gross revenue.

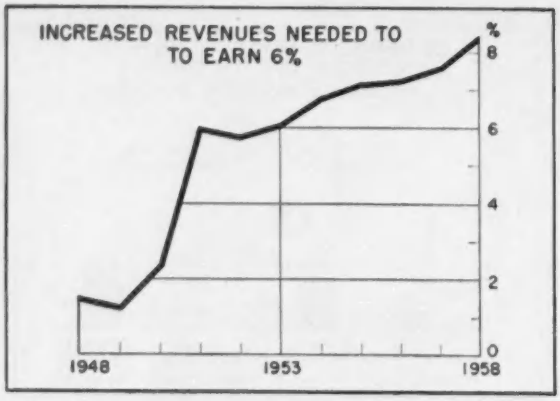
As electric utility investment is high, as compared to the general manufacturing industry, investment ratio is particularly important to electric utilities. Since 1948 earnings available for return on investment of our hypothetical company has increased. This has been due, largely, to some rate increases and the operation of new, more efficient plants. However, this increase in funds available for return on investment has not been enough to halt the downward trend in percentage return on investment as shown in Chart 1.

In 1933 the industry's investment Chart 4, was about $7.00 per dollar of gross revenue. That was because equipment was not being used to its fullest. Today the ratio is lower because the industry is operating at a better load factor and with less reserve.

But, the investment ratio is based on the cost of plant in service, both old and new. Since the cost per kw of all new equipment is about double



9 Per cent return continues its downward trend. It will be about 5% by 1957 if new business promotional campaign is continued



10 Gross operating revenues will have to rise above normal trend each year as shown above if 6% return is to be earned

what it was 10 years or so ago, it is probable there will again be a steady rise in the investment ratio. The electric utility industry cannot stop the steadily rising construction costs in today's market.

An increase in load factor would help this situation. Operating load factor has been rising, Chart 5, but there is opportunity for more improvement. If a company is operating at 60% load factor, and has roughly 10% of its capacity in reserve, such a company is utilizing its investment about half of the time. Any improvement here, with proper rates, will improve the percentage return on investment.

Load factor rose to about 64% during the war, when factories operated on three shifts. It dropped after the war, but has risen slightly to about 60%.

While construction costs have been rising, other costs for our hypothetical electric company have also been going up. Cost of capital has risen as shown in Chart 6.

Increased cost of fuel has more than offset the improvement in efficiencies of generating stations, Chart 7.

When the trend of cost of making electricity to the electric companies is downward, Chart 8, it means that the incremental cost of making electricity is less than the average cost.

With increased uncontrollable expenses and increased unit investment costs, we notice a change in the curve occurring in about 1944 as shown on Chart 8.

Work Toward Per Cent Return . . . All rate and new business programs should be designed in the light of this significant change. It is likely temporary but will probably continue until the wholesale price index levels off or declines. Therefore, all rate increases should carry a margin. New business programs should be designed accordingly.

The fact must be publicized that while the cost of living index is trending sharply upward the cost of residential electricity continues its downward trend. A public opinion survey shows that 55% of the people who were asked about the price of nine items of personal expense thought that electricity was the most reasonably priced.

Calculations have been made to determine the per cent return for our hypothetical company for the years through 1957 under the following assumptions:

1. The wholesale price index continues to rise slightly.
2. The electric rates remain the same as to level and style as they were in 1952.
3. The company continues the same new business promotional program as in the year 1952.

On this basis the per cent return would continue with the downward trend from 5.3% to about 5%, Chart 9.

Rate increases are necessary to correct this situation. The necessary increase in gross operating revenues (above the normal trend) each year in order to bring the hypothetical company to a 6% return are shown in Chart 10.

It is significant to note this is a rising percentage increase over the years, meaning that it would be sufficient for a company to obtain an increase of only enough to bring the company to a 6% return for the current year. Such a company would have to repeat the rate case for an additional increase in the following and each year thereafter.

Public Service Commissions of the country should recognize this and allow a sufficient increase to take care of a company for at least three or four years.

While operating in an economic climate of rising costs, it would seem advisable for each company to make a cost analysis, with all of its limitations, to determine which rates go below cost for increased sales. If rates are to be increased, the style, form and shape of each schedule should be designed in such a way as to give the desirable results under present economic conditions.

Rates for increased sales or follow-on steps should be raised sufficiently above cost to provide a reasonable margin in order that a company may improve its position through a well designed sales program.

In addition, the company should design its sales program not entirely on the basis of volume or even net revenue, but rather on the basis of building load factor and per cent return.

New Power Transformer Standard Offers Many Advantages to Utilities

H. M. JALONACK, Chairman
ASA C57 Subcommittee on Power and Distribution Transformers,
General Electric Co, Pittsfield, Mass.

In answers to 18 questions the chairman of ASA C57 subcommittee . . .

- **Presents objectives of the new transformer standard in terms of user benefits**
- **Interprets significance of changes introduced by the standard**
- **Explains the reasons and bases for standardization action taken**
- **Cites the objectives yet to be achieved**

The American Standards Association has just made available "ASA C57.12a-1954," a new American Standard covering requirements for transformers with high-voltage ratings of 2,400 to 67,000 inclusive with low-voltage ratings 480 to 14,400 inclusive. The sizes covered are 501 through 10,000 kva, 3-phase and 501 through 5,000 kva, single-phase. This new standard, approved Jan. 15, covers, with certain additions and modifications, the same general area as the previous publication C57.12a which was issued as a Proposed American Standard in March 1952.

The questions and answers given in this article should help to explain more fully the significance of the new standard and the changes that have been incorporated during the interval between its "proposed" and "standard" status.

Question 1. What is the broad objective of this standard?

Answer: The broad objective is to establish a sound set of requirements which cover the basic electrical, mechanical, and thermal needs of a substantial majority of users and yet which provides flexibility in application. An immediate result is that the manufacturer is provided an opportunity to standardize and quantity-produce many mechanical parts, to simplify design engineering procedures, to reduce ordering and stocking routines, to cut down manufacturing cycles, and in many other ways to reduce cost. In turn the users profit in the form of lower prices on the standardized designs and in substantially shorter delivery time. In addition, advance knowledge of the location of bushings, accessories, and other mechanical parts cuts to the minimum the user's time and expense of preparing for the installation of the unit. The user's specifications are greatly simplified as it requires only a small amount of basic data to supplement the ASA Standard requirement.

Other advantages are greater interchangeability between designs of different manufacturers and between designs of the same manufacturer built at different times and successful parallel operation between transformers conforming to the standard. The user also has the assurance that because the various details in the standard have been carefully reviewed by the industry, units properly constructed in accordance with the sandard should fully meet user's needs. There will, of course, be special conditions where the standard cannot be utilized.

Question 2. Will these standards restrict the manufacturer in the development of new ideas and of an improved product?

Answer: Quite the contrary. The standard does not cover at all many of the areas of design advancement such as loss reduction, core or winding improvements, new and better materials, improved methods, or any of the details of mechanical or electrical construction. In this area a healthy rivalry between manufacturers continues to exist. The end result is a steady and important improvement in product quality. Actually by being relieved of the monotonous and seldom-constructive task of making constant variations in locations of parts and accessories, a much higher percentage of design engineering skill and drafting talent can be utilized for developmental work of the type leading to real progress.

Question 3. Why were these particular ratings selected for inclusion in the standard?

Answer: These ratings, which adjoin the voltage and kva group commonly termed "distribution transformers," represent those power transformers which an extensive poll

of recent practices has shown to be most acceptable in a standardized pattern to users. The system areas where they are used are very similar between various users; whereas in the larger kva and higher voltages, unusual conditions of voltage, system operation or tie-in requirements often require transformers tailored to those particular conditions. However, it is quite possible that at a later date another group of ratings, either of higher voltage, or higher kva level, or both, may also lend themselves to standardization.

Question 4. Part II of the standard covers additional mechanical and electrical features. Just what is its relation to the standard covered by Part I?

Answer: The basic electrical characteristics and mechanical features are covered in Part I of the standard. However, certain requirements by users still enable standardized parts to be used, detail drawings to be available in advance, etc, without the necessity of designing and building a completely special unit. In such cases it would be unrealistic to say that the transformer is completely out of the standard class, and these cases are covered in Part II of the standard.

For example, Part I standardizes the most commonly used primary voltages all of which were selected from the EEI-NEMA Report on Preferred Voltages for A-C Machines and Equipment. Assume a system operates at 19,030 v. To convert the standard 150-kv BIL unit from a rating of 22,000 v primary to 19,030 v does not involve any major change, but a new winding specification has to be prepared. This involves certain engineering design changes representing a moderate cost addition. The transformer thus falls within the general area of the standard but is classified under Part II as possessing optional characteristics and features which may be required for some applications. Thus the purchaser may select vitally needed modifications yet still obtain most of the economic benefits of the standard as long as he does not also specify modifications which change basic design and construction.

Certain features such as terminal boards permit a user who now requires features that are not a part of the basic standard to buy an optional standard transformer that will permit later changing to the basic standard. Such features will facilitate a transition from present operating practices to the basic standard over a period of time.

Question 5. How did the committee decide what optional items should be included in Part II?

Answer: The cost and complexity were weighed against expected usage. Simple items such as skids and lifting beams are included even though they will be specified infrequently. On the other hand terminal boards are an expensive complication and were included only after thorough study showed widespread need for this feature.

It must be remembered that all these Part II features affect the basic design because provision must be made in the basic design for their addition when specified.

Question 6. What sources of information have been available to the ASA C57 subcommittee in developing these standards?

Answer: The Transformer Section of NEMA, the Edison Electric Institute, AIEE, ASA staff, AEIC, ASA Sectional Committee to which the C57 subcommittee reports, and many individual users have contributed valuable help in the formulation of the standard. As a further check, items in questionnaire form are at appropriate times circulated to a wide list of advisers, covering the general area of transformer usage.

Question 7. Can you give an estimate of the possible savings to users resulting from this standard?

Answer: Any savings can only result from the widespread utilization of the standard which means its widespread and enthusiastic acceptance by the purchasers of transformers falling within its scope. Even during the period when the standard was in the "proposed" classification, approximately 35 to 40% were specifying standard units. Assuming that this percentage can be raised to 75 to 80% by the new standard which seems entirely probable, the savings in the next three years alone will exceed $10 million as compared with the purchase of non-standard units. There is every evidence that the new standard has been anxiously awaited both by users and manufacturers which promises well for its widespread ultilization.

Question 8. In the proposed standard, the 2,000 kva, 3-phase rating was completely omitted. Now 2,000 kva has been included for 3-phase transformers with low-voltage ratings of 2,400, 2,520, 4,160Y, or 4,360Y. What was the reason for the original omission, and why was this rating put back in the final standard?

Answer: Of three sequences of kva submitted to the established list of advisers, the sequence included in the proposed standard was approved by 106 of the 117 replying. However, it developed later that in unit substation equipment 2,000 kva had been a particularly popular rating. In this rating substation, for secondary voltages of 4,360 v and below, a circuit breaker with an interrupting rating of 50,000 kva was utilized. By eliminating the 2,000-kva rating and going to 2,500 kva as the next step above 1,500 kva, the interrupting requirements, after allowing for the transformer impedance and for the derating factor in reclosures, would have meant going to a 150,000 kva breaker at substantially higher cost. It was considered highly undesirable to retain 2,000 kva for unit equipment transformers while omitting it for conventional power transformers. The decision was made, therefore, to put back 2,000 kva for those ratings where the secondary breaker would otherwise be unnecessarily costly. As the same situation did not apply to single-phase units of equivalent bank capacity, it did not appear necessary to re-establish 667 kva as a standard single-phase size.

Question 9. In addition to the provision made in the proposed standard for a range of top-oil temperature through which the transformer would remain sealed there is now a provision for the minimum and maximum temperatures for which the transformer should be suitable. In what way does this change add to the suitability of the standard transformer?

Answer: Initially it was felt that the establishment of a range of top-oil temperature through which the transformer would remain sealed would cover all practical needs. Later discussion at committee meetings definitely indicated that there were other considerations of temperature beyond that of range of top-oil temperatures or the well-established limits of temperature rise, ambient, and hot spots. If for example, a transformer previously filled to its correct level at the filling temperature were placed in service at −10C would the top-oil level be so that vulnerable parts were exposed? Again, if initially filled to the right level, would it be suitable for operation after standing in the sun until its top-oil temperature was plus 80C? Considering that transformers of ratings covered by the standard might be installed anywhere in the United States, what would be reasonable temperature limits? After a survey of users and manufacturers it was decided that a range of from −20C to +95C would cover practically all of the conditions met in the U. S. It was felt that ranges of top-oil temperatures beyond this would not be economically justified as in exceptional situations the oil level could be adjusted temporarily and readjusted later.

Question 10. In the proposed standard a 3-phase transformer had three low-voltage bushings even though the transformer was permanently wye-connected on the low-voltage side. In the new standard such a transformer has four low-voltage bushings. As four bushings are obviously more costly than three-bushings, is this added feature justified?

Answer: In the proposed standard, Part II included a paragraph whereby the fourth bushing could be specified when needed. Later a much more complete analysis of wye-connected low-voltage systems showed that most of such Y-connected system were grounded at the neutral, either directly or through resistance. Even those not grounded might quite probably be grounded at a later date. Furthermore, the neutral bushing is considered a desirable standard as it permits the user to insulation-test the transformer periodically without opening or breaking the seal to remove ground connections. Part II of the standard is intended to cover the exception rather than the rule, and if the neutral bushing stayed there, it might be overlooked and prove difficult and costly to add later. The concensus was that the neutral bushing really belonged in Part I so that is where it now is.

Question 11. One of the most important additions is the establishment of mechanical dimensions on bushings in the 25, 34.5, 46, and 69-kv classes, one group of ratings also covering bushings suitable both for transformers and circuit breakers. For years, we have been hearing that this was completely impractical. How was this finally accomplished, and what is its significance to transformer users?

Answer: For many years the number of different types of bushings, even in a single-voltage class, have been increasing. The bushings of one manufacturer's transformer did not fit another manufacturer's unit. Often a single manufacturer over a period of time would produce bushings not interchangeable with his own previous bushings. Attempts at an individual manufacturer's standardization often resulted in "just one more new bushing." The problem was a constant aggravation to users who accumulated greater and greater stocks of spare bushings only to find that in an emergency even they wouldn't fit. The manufacturers were often called on to supply special transformers to match existing bushings or to design various and time-consuming types of adapters.

One of the major obstacles to standardization was that no one manufacturer's designs or no one user's preferences could be accepted. All would have to make substantial compromises to achieve acceptance. Furthermore, much detailed information had to be obtained from transformer manufacturers to make sure that the transformers would not have to be made bigger and costlier to accommodate them to the new bushings in which case the tail would wag the dog. However, various groups of users around the country became convinced that with the huge expansion of electric facilities ahead, the time was "now or never" to make the sacrifices necessary for standardization. Encouraged by this viewpoint, the transformer manufacturers, bushing manufacturers, and users got together, and after very considerable discussion, investigation and compromise a workable set of standards was developed.

Question 12. Does mechanical standardization of bushings mean complete interchangeability of bushings in a given voltage class between transformers of different kva ratings and between transformers made by different manufacturers?

Answer: No, it does not. A review of tables which cover the mechanical standards on bushings shows that in each voltage class there are a number of possible lengths of bushings below the gasket surface. While the standard bushings are to be selected from these tables, one type of oil preservation may require a short internal length, an alternative type another. One size transformer may require a different internal length than another. One manufacturer may design to use only one internal length for all bushings in one voltage class, another may use several internal lengths to cover the range. There are also several current ratings available. In spite of such limitations, the mechanical standardization does mean:

a. A substantially smaller total number of bushings for users to carry as spares.

b. Greater ease in emergency application of available bushings because of standardized bolt circles and bolting arrangements.

c. A much greater interchangeability of bushings than has hitherto been possible.

d. Standardized external terminal stud so that for a given current rating a user can apply his own choice of conductor clamping arrangement.

Question 13. Although mechanical characteristics of bushings are established in the standard, the electrical characteristics are omitted with a statement that they are presently under consideration. How can the new bushings be considered standard if the electrical characteristics, creepage, BIL, etc. are undetermined?

Answer: They can't. However, the electrical characteristics have been under consideration simultaneously with the mechanical dimensions both by transformer and switchgear users and manufacturers. It is hoped it will only be a very short time before the standard will be supplemented by standardized electrical data to complete the bushing standardization in the four voltage classes covered.

Question 14. In the proposed standard the 25C liquid level was stated as being the "distance from the liquid level to a convenient reference point." This is made much more specific in the new standard by establishing this dimension as "the distance from the liquid level to highest point of the handhole or manhole flange surface." Was this change necessary?

Answer: The trouble with the old wording was that it was indefinite. It was something like agreeing to meet a friend "at a convenient point." He wouldn't know which you meant unless you told him. Here a point that was available on all manufacturer's transformers and was convenient to all users was made specifically known to avoid confusion and assume consistency of application by transformer users.

Question 15. It is noted that several features have alternate standards such as both sealed-tank and gas-oil seal for certain kva ratings and BIL levels and both bolted or welded main cover construction. Would it not be more economical to have a single standard cover any specific function?

Answer: It would. However, the process of arriving at a single standard involves obtaining quite substantial agreement by users and manufacturers to assure widespread acceptance later. In these two instances the alternate constructions were submitted to interested groups with the objective of obtaining a single specification. Several trials showed that opinion was almost evenly divided with rather strong indication that the non-favored construction would be completely unacceptable. Under these conditions both constructions were included as standard with the hope that additional experience and background data would permit alternate construction to be eliminated.

Question 16. In Part II of the standard forced-air cooled rating of the 2,500-kva transformer which was previously given as 2,875 kva is now shown as 3,125 kva which indicates that 25% additional capacity is available for ratings 2,500 kva and larger. On sizes 750 to 2,000 kva the increase for forced air is 15%. What is the reason for this difference, and why are the percentages so low?

Answer: The transformers covered by this standard are basically designed as self-cooled units, and actually most of them are used this way. The forced-air cooling on these ratings is designed to take advantage of any inherent additional cooling available from fans without increasing the physical size, and, therefore, the cost of transformer as a self-cooled unit. The original studies of the available capacity of transformers 2,500 kva and smaller indicated a reserve of 15% with fans and on the larger ratings of 25%. It was agreed by the manufacturers at the time and proposed standard was developed that further study would be made of fan possibilities. This study to date disclosed that 2,500-kva rating could have a forced-air rating of 25% instead of 15% and the new standard includes the higher figure.

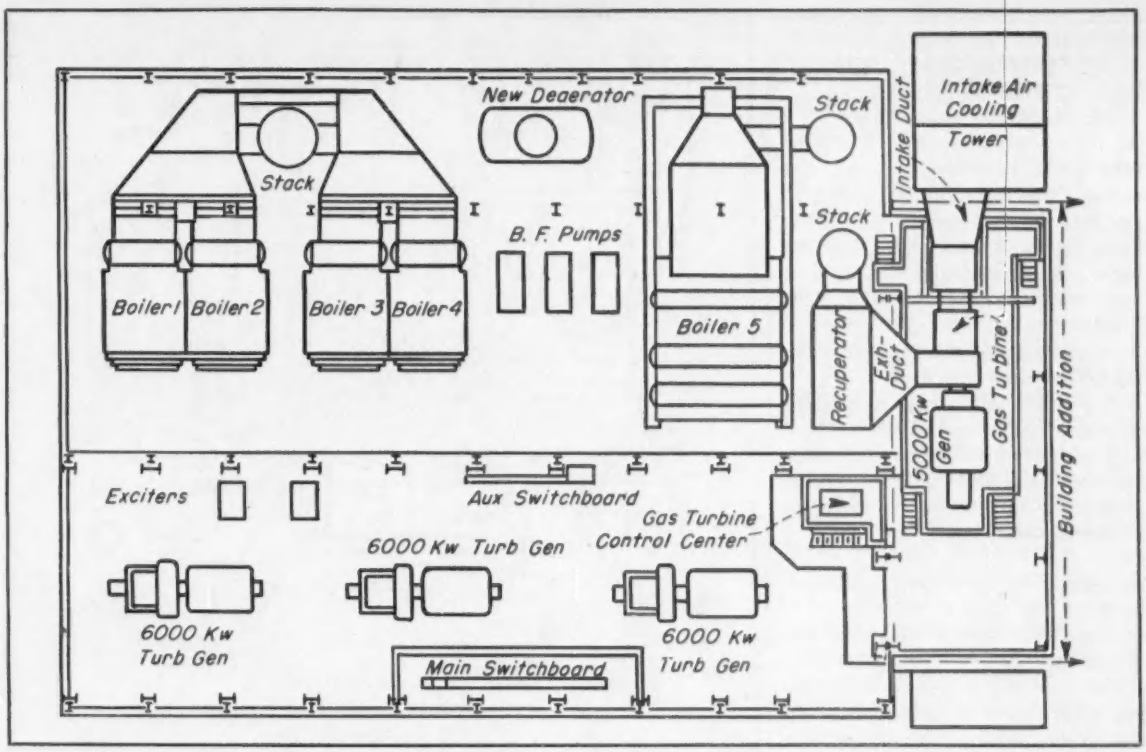
This situation should not be confused with transformers of substantially higher kva rating than this standard covers, where high velocity fans can economically produce still higher increases in rating than are practical for the lower kva ratings.

Question 17. It is noted in Part II in the 34.5-kv class, the range of "other high voltage ratings" has been changed from 26,400-v minimum to 25,700-v minimum. Other voltages remained unchanged. What is the significance of this change in one group of ratings only?

Answer: Table 9 in Part II of the standard is designed for users who cannot use the high voltage ratings in Part I but who can use the remainder of the standard. It was known originally that there was substantial usage of 26,400-v transformers, and this voltage was, therefore, included in Part I. In Part II, Table 9, other voltage ratings in the 200-kv BIL group started with a minimum rating of 26,400 v as it was thought this was the lowest voltage rating required at this BIL level. It developed later that this was 700 v too high to meet the actual ratio needed. Investigation showed that no increase in cost of basic design parts was required to lower the acceptable range in voltage by 700 v, and the standard was modified accordingly. Had this situation been known initially, it could have been included in the proposed standard.

Question 18. Part II now includes several terminal board arrangements for 3-phase transformers to provide for both a standard and a non-standard phase displacement. Does this not encourage the continuation of non-standard phase displacement?

Answer: Its purpose is just the reverse of this. A number of large utilities in the United States have not been able to take advantage of the savings from standard transformers because of the large number of existing 3-phase units on their system having phase displacement built to an earlier standard now superseded. By selecting transformers from Part II for future purposes, they will be able to operate in parallel with their existing units. When such older units reach the point of being a minority factor in the system, it will be possible to retire the older units, shift the units now purchased to standard phase displacement, thus eliminating the need for the terminal boards on transformers subsequently purchased. The same thinking applies to this feature as to series-multiple and Y-delta boards, the need for which may largely disappear as systems approach the ultimate phase arrangement and voltages desired.



GAS TURBINE of 5,000-kw capacity was installed in the steel and corrugated asbestos building attached to the Rio Pecos Plant during renovation of the existing plant cycle, consisting of three 6,000-kw turbine generators. Re-designed piping cut inherent losses

Gas Turbine Ups Plant's Efficiency

West Texas Utilities applies installation to old steam station at Rio Pecos and gains 15.15% in thermal efficiency, 32% in dollar economy, and generating capacity increment of 6,611 kw at $76.37 per kw cost

LOUIS S. GEE, Mechanical Engineer, West Texas Utilities Co, Abilene, Tex.

Application of a combustion gas turbine to the cycle of an old steam plant recently on the West Texas Utilities Co's system promises an increase in thermal efficiency of 15.15%. At an installed cost of only $76.37 per kw, this increased thermal effiiciency will result in an over-all plant dollar economy of 32% and a generating capacity gain of 6,611 kw.

This application to an old steam installation stands out at a time when engineers are focusing attention on new plants with higher pressures and temperatures in the constant search for more economical generating methods. It was made only after careful analysis of the costs involved.

The low investment in old equipment with its high generating cost was weighed against the much more expensive new units with a lower production expenditure. This analysis showed the advantage of retaining older units and cutting unit production costs by increasing the old plant's thermal efficiency and capacity. Formerly this was accomplished by installing topping steam turbines.

The topping steam turbine, however, has several disadvantages. New high-pressure, high-temperature equipment constitutes a considerable investment. Furthermore, a topping steam turbine requires old equipment to operate at a high capacity and load factor. The topping steam turbine cannot operate economically alone.

Boiler Eliminated . . . The new gas turbine-steam turbine cycle not only elminates a boiler, but it can be operated in accordance with the exigencies of the system load. It also provides a prime mover that can "stand alone."

The new gas turbine-steam turbine cycle was developed through studies to determine the most practicable means of boosting capacity and efficiency of the old plants at system load and capacity factors. The studies included intropy balances of the old plants to determine all cycle losses.

These old power stations have multiple boilers, turbines using common headers, and common feedwater heaters to receive extraction steam from headers common to all turbines. Steam is delivered to the turbine between 250 and 350 psig and superheated 150 to 250 F, respectively. The old units have feedwater cycles consisting of low pressure heaters,

From paper presented at American Power Conference March 26, 1954

evaporator condensers, open type deaerating heaters, and high pressure heaters. Feedwater heating and evaporation of make-up are performed by steam extracted from turbines.

New Cycle Features . . . The new power cycle incorporates many new features in combination with the steam turbine cycle. Some of the more important design features are:

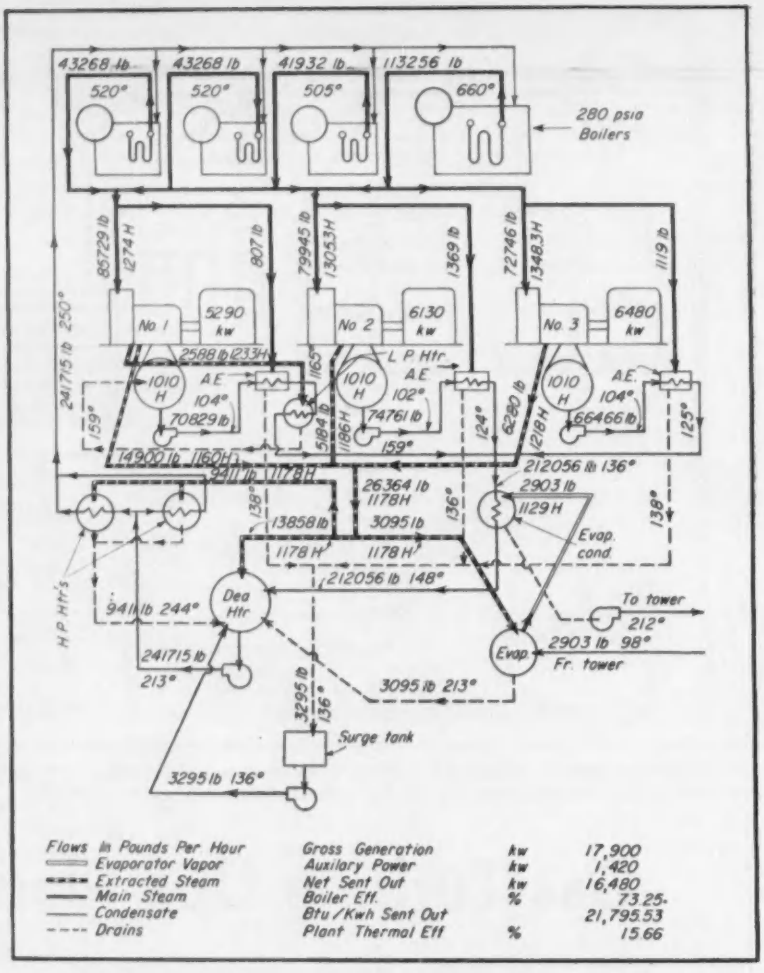
1. Renovation of the existing plant cycle.
2. Application of the gas turbine to the plant cycle.
3. Use of the gas turbine compressor to supply station control air.
4. Combination of one cooling tower for cooling and washing the gas turbine compressor inlet air while removing heat from the oil cooler and generator coolers.
5. Location of the conventional recuperator in the cycle.
6. Method of control used with the recuperator.

Although the study was made for old plants, subsequent studies show that the new cycle can be incorporated in all power stations in the company's system.

Old Plant Cycle . . . The first plant to be renovated and to have the gas turbine applied was the Rio Pecos Station at Girvin, Texas. The cycle at this plant consisted of three 6,000-kw turbine generators of 1927 vintage. Throttle conditions were 280 psig 525 F, 280 psig 580 F, 280 psig 660 F respectively.

The different throttle conditions were caused by the physical arrangement and condition of three small boilers and one large boiler which deliver steam to the turbines through a common header. The old feedwater heating cycle contained four feedwater heaters and one evaporator condenser. Condensate from the No. 1 unit passed through the air ejector and a low pressure heater to a common header. Condensate from No. 2 and No. 3 units passed through their air ejectors to the common header. There, condensate from all units mixed and passed through an evaporator condenser, open heater, boiler feed pump, and two high pressure heaters in parallel to a common header and that fed all boilers.

Condensate heating and the evaporation of make-up was accomplished by steam extracted from all three turbines. This steam flowed to each heater and the evaporator through a network of common headers. Evaporator condenser drain, air ejector drains, and all high pressure drains went to a surge tank. The surge tank overflow was pumped to a high, or storage, tank. The cycle balance was maintained by water from the high tank returning to the deaerator through a float valve. Losses due to throttling of extracted steam, make-up system losses, pipe leakage, and the lack of thermal insulation were numerous.



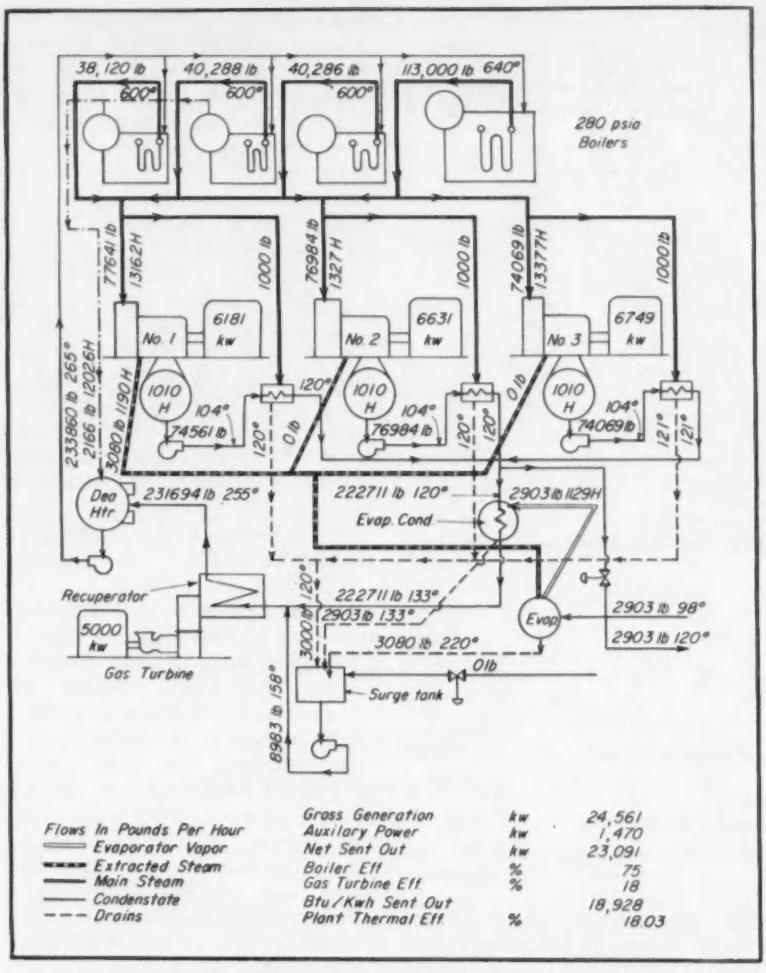
PERFORMANCE of the Rio Pecos steam plant before renovation and installation of the gas turbine was poor, the equipment dating back to 1927. Cost was incentive for retaining it

Plant Renovation . . . During renovation of the old plant, the feed water heaters were replaced by one high pressure deaerating heater. New superheater elements and baffles were added to the small boilers. New condensate pumps of greater capacity and head were installed. A new motor-driven feed pump replaced a steam-driven one. Modern cycle controls were installed when required.

During installation of the new equipment, the piping was re-designed to accommodate not only the new steam plant equipment and the gas turbine recuperator also, but to eliminate many inherent losses of the old plant cycle. All plant renovation was done in a manner to insure the maximum gain from the gas turbine.

This renovation eliminated many of the old cycle's inherent losses while enhancing the application of a gas turbine-steam turbine cycle. It also enabled personnel to be relieved of operational duties so that they might operate and maintain the new equipment without additional personnel.

Gas Turbine . . . The new cycle will be composed of the old steam turbines, evaporator condenser, one or more gas turbines and their recuperators, and a new deaerating heater.



RENOVATED station with the gas turbine installed was the result of studies to determine most practicable method of boosting capacity and efficiency at lowest expenditure per kw

The 5,000-kw gas turbine was placed in a steel and corrugated asbestos building attached to the present plant.

The gas turbine generator unit is elevated about 8 ft above ground level to provide easy access under the unit for inspection and maintenance and to utilize better floor space. A removable, grille floor was installed as an operating platform around the turbine. All gas turbine generator auxiliaries, including neutral grounding equipment and surge protective cubicle, are under the operating platform.

To minimize duct losses, all runs were kept to the shortest possible length while retaining sufficient flexibility to permit the gas turbine to be lifted from its foundation without disturbing the ducts.

Operating controls for the gas turbine and recuperator are located on a platform immediately above the electrical control center inside the old building adjacent to the gas turbine. The generator control board is placed alongside the old existing switchboard.

Controls . . . Station control air is bled from the gas turbine compressor and used to operate all the pneumatic controls throughout the entire plant, thus eliminating the need for a main station control air compressor. Only a small, inexpensive, standby compressor for use during gas turbine maintenance was required.

The inlet air cooler cools the compressor inlet air during high ambient conditions and the circulating water from the turbine oil cooler and the generator air cooler. Capacity of this cooling system is such that it does not reduce gas turbine capability and eliminates a second cooling tower.

Circulating water for oil and air coolers is drawn from the cooling tower basin. During high ambient conditions this water is circulated over the top of the tower. During icing conditions it is discharged into the cooling tower basin at the most remote point from the circulating pump suction.

Recuperator . . . A conventional recuperator is placed at the most economical level in the cycle with regard to cost of equipment per Btu recovered. The new superheater elements permit hotter feedwater and improve efficiency of the small boilers.

The gas turbine is base loaded at its maximum capacity of 5,000 kw while the steam turbines take load swings. All condensate from the steam turbine hotwells and the station drains passes through the recuperator at all times. The desired heat recovery in the recuperator varies in direct proportion to the flow of condensate. The recuperator is designed for full steam plant load conditions. A controlled portion of the gas turbine flue gasses is bypassed around the recuperator during partial steam plant loads. The bypassing prevents steaming in the recuperator.

Heat Recovery in Recuperator . . . Desired heat recovery in the recuperator is maintained and controlled by a two-element, air-operated system. This system is designed to maintain a constant difference in the temperature of the condensate leaving the recuperator and the temperature of the feedwater leaving the deaerating heater. The temperature of feedwater leaving the deaerator corresponds to the saturation temperature of the steam heating the condensate in the deaerator. Temperature of the condensate leaving the recuperator is maintained at the maximum which allows sufficient temperature rise in the deaerator to insure proper deaeration.

The two-element, air-operated recuperator heat recovery control system consists of two water-temperature transmitter controllers, one water-flow transmitter, one standardizing relay, one totalizing relay an air-operated control drive, a hand-automatic control selector valve, an air filter and pressure reducing station, and a three-pen temperature and flow recorder.

Volume of water being heated actuates the first control element which sets up the initial demand for heat requirement in the recuperator. The signal initiated is sent to the air relays which cause immediate ex-

Cost Breakdown for Gas Turbine Installation

	Equipment and Material	Installation	Total Cost Installed
Building Addition			
Foundations	$ 2,000	$ 3,386	$
Superstructure	12,302	13,736	
Crane	12,325	800	
	26,627	17,922	44,549
Generating Unit & Auxiliaries			
Turbine generator	460,000	12,750	
Turbine generator foundations	1,800	6,160	
Cooling tower including basin	6,055	5,000	
Pumps and foundations	2,281	1,540	
Recuperator and controls	38,239	7,000	
Stack and ducts including insulation	23,176	2,700	
	531,551	35,150	566,701
Electrical in Place			
Substation including transformer, breakers, structures, etc.			60,000
Control centers, protective equipment, boards, etc.			57,168
Total Cost Gas Turbine Addition			$728,418
Renovation Old Plant			
Deaerator installed			$ 20,000
Superheaters installed			45,872
Pumps and foundations installed			8,909
Piping installed			12,432
Air compressor installed			1,098
Controls installed			999
Total Cost Plant Renovation			$ 89,310
Retirement Old Equipment in Steam Plant			
Total Amount of Retirement			$ 80,962

haust duct damper positioning. The dampers cause part of the turbine flue gas to bypass the recuperator.

The second or readjusting element is controlled by the difference in the temperature of the water between the recuperator outlet and deaeratnig heater outlet. Two water-temperature transmitters measure the temperature of condensate at recuperator outlet, and the temperature of feedwater at the deaerator outlet. These set up pneumatic loading pressures causing readjustment of the exhaust duct dampers until desired temperature difference between recuperator outlet condensate and deaerator feedwater outlet is obtained.

To safeguard the recuperator against steaming, two safety devices reduce or prevent flue gas flow through the recuperator at low condensate flows. A pressure switch in the air-loading line of the condensate flow transmitter operates when the loading pressure drops to 5 psi, zero flow and drops air pressure on the damper air controlled drive. This bypasses all flue gas around the recuperator.

When the recuperator condensate outlet temperature rises, an alarm sounds. When the temperature continues to rise, the gas turbine tripping circuit is energized as condensate saturation temperature is approached.

Deaerator . . . The deaerator also exercises final feed water temperature control although it is not used for such control when the gas turbine is in operation. During gas turbine overhaul the deaerator heats and deaerates the feedwater by steam extracted from the steam turbines.

When the gas turbine is in operation, the condensate of all three units goes through their air ejectors to a common header. At the common header the condensate mixes and goes to the evaporator condenser, recuperator, deaerating heater, feed pump and the boilers. Steam for deaeration is supplied from the saturated steam drum of a small boiler. This steam heats the feedwater only 10 F. Since the turbine extraction pressure available was only 30 psia, a saving of approximately 3 million Btu/hr could be realized by using steam from the saturated steam drum of a boiler.

Performance . . . Performance of the Rio Pecos Station before renovating and application of the gas turbine is shown in the diagram. Performance with the gas turbine in operation is shown in another diagram.

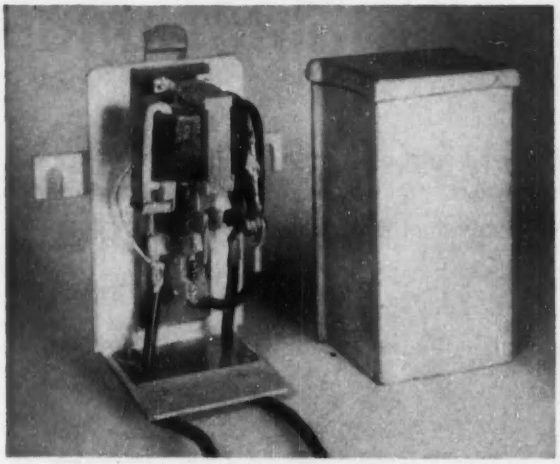
Discontinuation of extracting steam from the steam turbines and the new throttle steam conditions resulted in an output gain of 891 kw, 501 kw, and 269 kw from Nos. 1, 2, and 3 turbines, respectively. This meant that much of the reactive kilovars, needed in this area for voltage control, were no longer available from these three turbines at maximum steam plant output. An oversized generator was purchased for the gas turbine and a larger transformer was installed. The reactive capacity was gained in the new oversized generator at a much lower cost.

Operating Economies . . . Low total investment cost was obtained because of the inherent cycle design features. The new cycle incorporates the recuperator in the feedwater cycle next to the condenser hotwells or evaporator condenser. This location permits the smallest exchange surface to be used for a given amount of heat transfer. Also the pressure is used at its lowest practicable point in the cycle. The combination gives lowest possible recuperator cost.

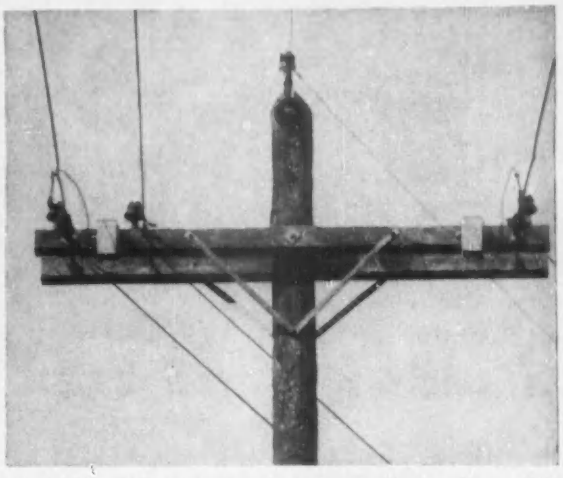
Deaerator use of saturated steam from a boiler insures against boiler feed pump destruction from flashing of feedwater at the pump impeller and enables the deaerator to operate at less height above the pump. This arrangement results in low deaerator installation cost.

The Rio Pecos Plant was renovated and the gas turbine-steam turbine cycle incorporated at a total cost of $817,728. During renovation, $80,-961.94 worth of equipment was retired. A great portion of the retired equipment will be re-used at other locations at less than current replacement costs. The net increase in station capitalization per kw net gain is only $111.45.

Taking into account the efficiency gains in the plant, this cost of $111.45 per kw net gain becomes even lower. Capitalizing the savings which result from efficiency gains in the old plant at 15% amounts to $231,860. Thus, a total of only $504,906 is strictly chargeable to increased plant capacity. Thus increased capacity was obtained for only $79.37 per kw net.



BREAKER CONSISTS of current coil and voltage coil, both acting on a plunger which operates the contacts. First were installed in 1949



INSTALLED at secondary junction points, breaker opens automatically under fault conditions, closes when conditions become normal

Breakers Aid Secondary Banking

San Antonio installs 2,200 of light-duty, inexpensive devices which isolate faulted section and eliminate cascading

RALPH E. BROWN, Substation Engineer, City Public Service Board, San Antonio, Texas

Difficulties in the operation of banked or networked overhead secondaries prompted the San Antonio Public Service Board to work with a manufacturer in developing an inexpensive, light-duty network breaker. Starting with a trial installation of 200 breakers in 1949, there now are 2,200 of these breakers on the San Antonio system. Operating results have been very satisfactory.

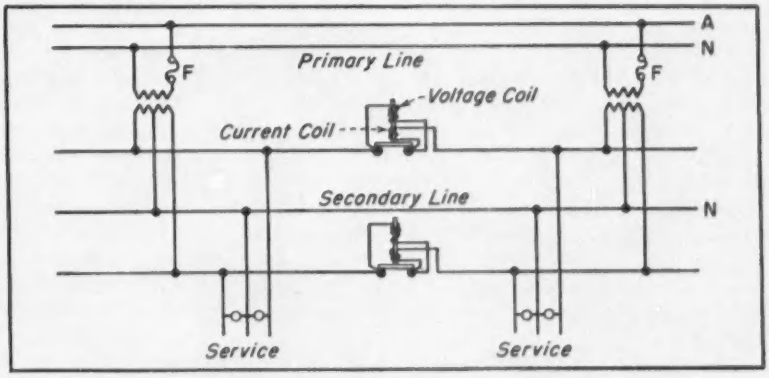
Difficulties which prompted the development were similar to those that apparently have been experienced on other systems. When fuses were installed in the secondaries between transformers, the choice of fuse sizes was difficult; and they had to be replaced when blown. Labor and fuse cost was considerable. Fuse locations were sometimes difficult to find, particularly at night. The tendency was to refuse the transformer and leave the junctions unfused. This eventually results in defeating the purpose of networking.

On the other hand when secondaries are tied together without fusing, a secondary fault would blow the fuse on the nearest transformer. If the network covers a large enough area, the transformer fuse farthest from the fault will not always blow because of low short circuit current. This often causes the transformer to burn out. If the transformers all clear, the result is an outage affecting a large number of customers, followed by the task of refusing transformers and restoring service. The latter is not always easy, sometimes involving a lineman at each transformer to close all cutouts simultaneously on a signal.

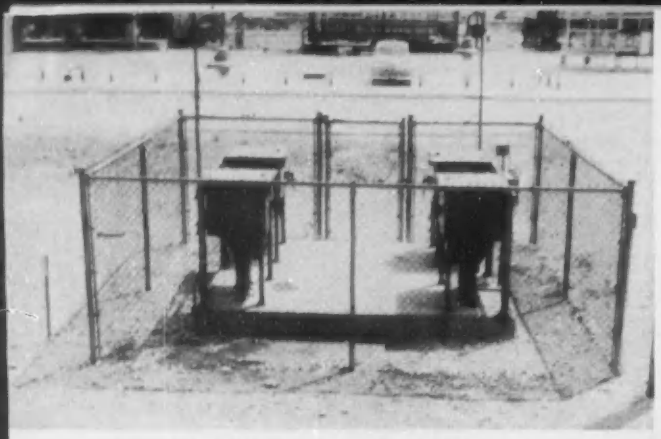
The new network breaker, designed for installation at secondary junction points, will open automatically under fault conditions and close automatically when normal conditions have been restored. It makes use of the fault current to open the junction point, and the voltage across the open junction to hold it open.

Essentially the switch consists of a current coil and a voltage coil, both acting on a plunger which in turn operates the contacts. The plunger is picked up by the current coil at a

(*Continued on page* 145)



PLUNGER, operated by current coil at predetermined current value, opens contacts. Line voltage across them keeps them open. Circuit through customer equipment keeps voltage coil energized. This prevents adjacent transformers from picking up load of faulted transformer



SWITCHING STATION at the Phillips Petroleum Co refinery at Kansas City, Kan., furnishes 13,200 v for processing 5,500 barrels daily

Distribution for

Requirements of high reliability and ease of expansion impose added burden on designer. Most common secondary voltage is 480

T. R. SHAW, Phillips Petroleum Co, Bartlesville, Okla.

Design of electrical distribution systems for modern chemical plants and petroleum refineries must be kept simple and flexible to meet the exigencies of these fast growing industries. It must stress reliability. A power failure in a refinery halts production and in a hydrocarbon plant causes a shutdown of a week or longer while a unit is decoked or a catalytic cracker unplugged. Cost of the electrical distribution system is only a small part of total plant cost; yet it must be reasonable.

In chemical plants and petroleum refineries most of the load is integral-horsepower, polyphase, induction motors. Loads are usually grouped, and groups vary with each plant. The electrical designer usually finds it difficult to obtain a close estimate of running loads and maximum demand because service reliability requires much standby equipment.

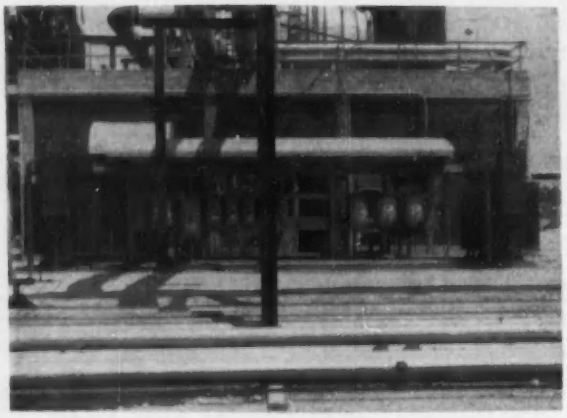
When he has investigated the cost of each of several desirable distribution systems, the designer must select one which can be expanded at a reasonable cost. He must choose primary and secondary voltages; plan circuit arrangements; settle on substation size, type, and location; and determine the type of system, whether overhead or underground, open wire or cable.

Selecting Voltages . . . Voltages usually are divided into three classes: 600 v and less, 2,400 to 15,000 v, and above 15,000 v. Those in the first group are usually utilization voltages.

The 110/220-v, single-phase system is economical for lighting and loads up to 50 kva. The 208/120-v system is usually more economical than other voltages when 50% or more of the equipment is operated at 120 v and the load is more than 50 kva.

The 240-v, 3-phase system is seldom economical. If 240-v can be used, 480 v can be used more economically. Substation, copper, switchgear, control equipment, and labor costs all favor 480-v. When safety practices are incorporated in the design and employed in working such circuits, proponents of the 240-v system are stripped of their best argument.

The 480-v, 3-phase, 60-cycle system is the most widely accepted for serving most petroleum and chemical plant utilization devices. Utilization equipment of all types and sizes is readily available in 440-v classification. In plants



DOUBLE ENDED substation has two 1,000-kva capacity, 13,800/480-v, askerel-filled transformers. 480-v secondaries are quite common

1,500 kva and smaller, the 480-v system can economically serve the plant for both distribution and utilization.

The 600-v systems have not been popular. Slightly less expensive than the comparable 480-v system, technically and theoretically, they should merit more consideration. But availability of utilization equipment has favored the 480-v systems.

The refining department of Phillips Petroleum Co has standardized on 480 v for motors up through 250 hp. For lighting loads it normally uses a 115/230-v, single-phase system. It uses some 208 Y/120-v, 4-wire 3-phase systems in buildings and specialty plants where load is over 50 kva and equipment is chiefly single phase.

While very small refineries find the lower voltages, 120 to 600 v, adequate for their purposes, most favor a system within the 2,400 to 15,000-v class. Extremely large refineries may find an even higher voltage economical. The trend is definitely to the higher voltage systems.

Studies indicate that for most plants 4,160-v systems are the most economical for demands between 1,500 and 10,000 kva. Plants with 10,000 to 20,000-kva demands usually require detailed study before either 4,160 or 13,800 v can be selected as the more economical. In general, plants with a demand above 20,000 kva are more economically served by a 13,800-v system. These ranges are for the ultimate or master plan of the plant.

After selecting voltages, the design engineer faces a wide choice of plant distribution system arrangements, the most usual of which are these: Radial, selective primary, selective secondary, ring bus, and network.

Selection is governed by requirements for service re-

Refineries Must Be Simple, Flexible

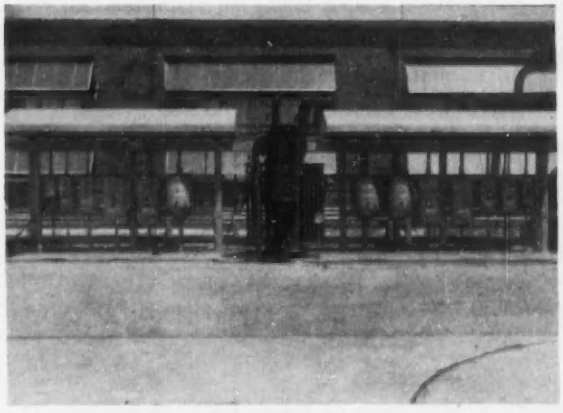
liability; maintenance; flexibility to encompass probable plant changes and growth; and the use of standard, readily available equipment.

The ideal system has both a primary and a secondary network, both with the proper relaying. Its expense is not warranted by most plant operations. The least expensive system is one having one primary feeder serving a number of transformers and a simple radial secondary system from these transformers. Considering all types of industrial plants, the simple radial circuit arrangement is about an 8-to-1 favorite. There is a great variety of arrangements between simple radial and network primary and secondary.

Phillips Petroleum has found 500 and 1,000-kva unit-type substations best suited for plants with 480-v secondary systems. With 208 Y/120-v secondary systems, the 300 and 750-kva unit substations serve best.

In choosing unit substations, the interrupting capacity of the secondary equipment is an important consideration. A 500-kva transformer with 3-phase, 480-v secondaries can have a short circuit current of 15,100 amp, and a 1,000-kva transformer a short circuit of 27,400 amp.

Load magnitude and primary and secondary voltages affect not only the economical selection of unit substations but also the selection of switchgear.



SINGLE UNIT, 13,800/480-v, 3 phase Phillips Petroleum substation has a 1,000-kva capacity. The transformer is filled with askerel

Circuit Protection . . . Short circuit protection must be designed not for just the equipment on hand but with an eye on the master plan for the refinery. Many plants today have inadequate short circuit protection.

The basic sources of short circuit current are generators, synchronous motors, condensers, and induction motors. The generator produces short circuit current after the short has occurred. It continues to produce voltage as long as field excitation is maintained and the prime mover continues to drive the generator. The current is limited only by the impedance of the generator and the circuit itself.

When the short circuit current reduces system voltage, the synchronous motor becomes a generator driven by its own inertia and delivers short circuit current to the system.

The induction motor also produces short circuit current for a few cycles after occurrence of the short.

In designing protection against short circuit currents, overload protection must also be considered. Such protection must be selected for each system. Overcurrent devices must have adequate, properly set, selective tripping, and the relay system should be the simplest that can do the job.

Type of Distribution . . . Types of distribution normally considered are:

1. Overhead on poles and crossarms
2. Overhead cables
3. Overhead conduit
4. Underground direct buried cable
5. Underground conduit and manhole system.

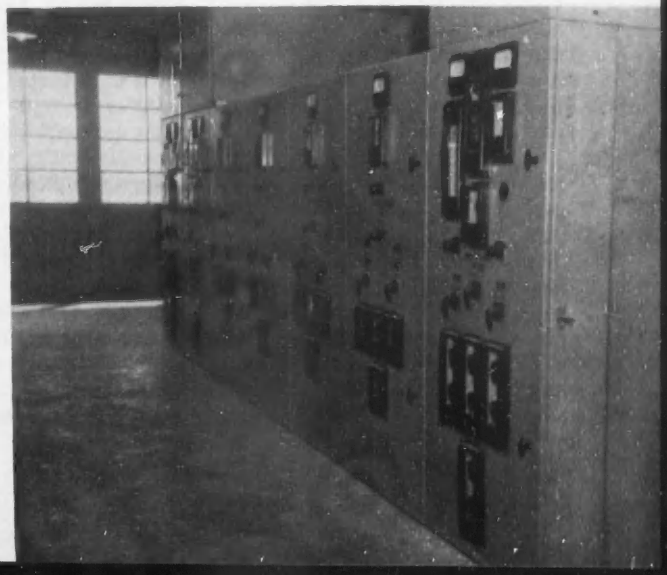
The overhead system, using crossarm construction, while the least costly, is the least reliable and the most hazardous within refineries. The reliability of an overhead cable system is somewhat better.

The overhead conduit system, in which the conduits run along the pipeways, has given fine service in some plants. Some safety men object to it, however, because it exposes the electrical distribution system to definite fire hazards.

Direct buried cables are satisfactory where the refinery is spread out, with considerable distance between the take-offs for load centers. Its service reliability is not affected by weather disturbances, fires, trucks, cranes, and other hazards to an overhead system.

The conduit, manhole, and cable system has all the advantages of the other systems except that it is more expensive. Most refinery distribution systems of Phillips Petroleum use underground conduits. One such system will be in operation 20 years this summer and has given the company the most that could be expected in service reliability.

BUS ONE of main refinery substation has three 13,200-v feeders from utility and four 13,200-v refinery feeder sections



PUBLIC RELATIONS AND ADVERTISING

Oklahoma G&E Sponsoring Color TV

Oklahoma Gas & Electric Co is sponsoring the first regularly scheduled local color television program in the United States. The first presentation was on April 26. The program, "Cook's Book," features cooking, interior decorating, fashions, and other items of interest to women. It is telecast five days a week and stars Mrs Sibyl Johnson. For the past two years it has been presented in black and white.

For the first color presentation Mrs Johnson had as her guests, Paul Hoheisel, left, advertising and publicity manager of the utility, and P. A. Sugg, general manager of WKY-TV, Oklahoma City, which telecasts the program.

SCANNING THE ADS

Carolina Power & Light Co—Head "The A-B-C of AFC" had each of the first three letters on a child's toy block. The last three letters stood for A Finer Carolina, a company-sponsored program to encourage civic improvement.

Georgia Power Co—Company introduced a new piece of equipment to its customers in an ad showing it in use. The equipment was a sky lift, a truck carrying an elevating crows nest for use by tree trimmers.

Northern States Power Co—A full page ad was used to brag to the public of the company's accomplishments of the past year. Page consisted of five large pictures and lengthy captions. Topics covered included: Company expansion of physical plant, increased use of electricity by farmers, taxes paid by the company, a Junior Achievement firm sponsored by the company, and calls made by home economists.

Pennsylvania Power & Light Co—Head on an ad illustrated by Reddy Kilowatt dressed in a chef's outfit and running, "The Man Who Came to Cook Dinner." The word cook was written in.

The company is advertising electric water heaters with a series of ads headed, "from THE FAMILY ALBUM." Each ad is a picture of a baby (a new set of babies, not the one used so many times in recent years) with the caption written in script below in family album fashion. Example: "Little Davey sneers at anybody who thinks there's a better, more economical way than automatic electric water heating!"

Public Service E&G Co—Ad offered a free copy of "The Riches of New Jersey." This 32-page booklet tells about the agricultural products of the state and home economics.

Better Living TV Show Lists Coming Programs

Additional programs for the "Better Living Television Theater," which is telecast at 10:30 PM (EDST) each Wednesday over the DuMont Television Network, include:

June 2—L. B. Smith, president, A. O. Smith Corp. Film: "More Power for Rio."

June 9—Frank Porter, president, American Petroleum Institute. Film: "American Frontier."

June 16—Kenneth Wells, president, Freedoms Foundation. Film: "Freedom and Power."

June 23—Clark King, executive vice president, Allegheny-Ludlum Steel Corp. Film: "Big Saul."

June 30—L. E. Caster, chairman, American Bankers Association. Film: "Mark of C."

Philadelphia Utilities Join in Identifying Employees

Four Philadelphia utilities recently published a joint newspaper advertisement telling the public how their service representatives and metermen can be identified. The purpose of the ad was to put a stop to the practice of unauthorized persons gaining admission to homes under the pretext that they are working for a utility.

An important part of the page ad was the full-size reproduction of the identification cards of the Philadelphia City Water Department and the Bell Telephone Co and of the identification badges of the Philadelphia Gas Works Co and the Philadelphia Electric Co.

'You Are There' to Close Season on June 20

The Electric Companies Advertising Program TV Show, "You Are There," will have its last performance this season on June 20. The show will return on Aug. 29.

The three last shows will be:

June 6—"The Decision of Robert E. Lee."

June 13—"The Fall of Parnell," sponsored by Prudential Insurance Co.

June 20—"The Trial of Anne Boleyn."

WASHINGTON COMMENT

JESSE MOCK

Congress has, for the time being, sidetracked an effort by federal power advocates to revive the—New Deal—interpretation of the preference clause.

However, Independent Sen Wayne Morse has promised at least one more try during the current session to overturn a fundamental part of GOP Federal Power Policy which involves administration of the preference clause. He came within a hair's breadth of accomplishing this feat in connection with a bill for marketing power from the Falcon Dam on the Texas-Mexican border (EW, May 3, p 75).

'New Deal' twist being considered on GOP federal power policy

Morse, with the help of several other public power Senators, will make another attempt to put a new deal twist on the preference clause when the Senate begins considering the Omnibus River, Harbors and Flood Control Bill later this year. In view of his near success on the relatively unimportant Falcon Dam bill, this will be something to watch.

Preference Clause . . . Legislative historians trace the preference clause back to a 1906 Reclamation Law. But for present purposes, it is enough to say that it is found in the Reclamation Projects Act of 1939, and the Flood Control Act of 1944. A more rigid version, of the type sought by Morse, is found in the Bonneville Project Act of 1937 and the Tennessee Valley Authority Act of 1933.

In general the preference clause found in these laws dealing with the disposal of federally produced power give priority to public bodies and rural electric cooperatives in purchase of such power. The Bonneville and TVA acts go as far as to say that these preference customers can purchase such power pretty much if, as or whenever they need or want it. The Flood Control and Reclamation acts are less specific.

The Falcon Dam power marketing bill contained the more general preference clause of the flood control and reclamation laws. Morse sought to write a more rigid interpretation of this clause not in the bill itself, but in the report which is not subject to full Senator approval. Such a report becomes an important legal document in showing the Congressional intent of the legislation.

If Morse had won out, this report would have also given a retroactive interpretation to the preference clause of the two earlier laws. The language Morse sought to put in the report was this:

"This provision would make applicable to this project the priorities provided in similar past legislation such as the Flood Control Act of 1944, namely, that electric power and energy will be marketed and will be made available to public bodies and cooperatives subject only to such requirements of notice as may be necessary to permit satisfactory planning."

Sen Morse Fails . . . As was recounted in the earlier story, Morse failed to get this language in the report only because one committee member suggested that Interior Department be consulted on the suggestion. Interior, which is charged with marketing the big share of federal power, promptly urged that the language be excluded from the Falcon Dam report, and this was done.

Morse made a token effort on the floor of the Senate to gain reconsideration by the committee, but was balked by Senators who thought this preference interpretation might come more appropriately in connection with the Omnibus Flood Control Bill, which is of the same type as the 1944 act now containing the preference clause.

New and Fair Dealers adhered pretty much to the Morse interpretation in administering preference clauses. This was a big boost to the preference customers, enabling them to use the low-price federal power to cut into the service areas of electric companies. It has frequently been charged that such an interpretation would lead eventually to a federal power monopoly.

Beginning last August, the Republican Administration sought a stricter interpretation of the clause—aimed toward preserving the general marketing patterns in federal power areas.

It is this phase of Republican Policy that Morse is out to overturn. Undoubtedly the persistent Oregonian will try again this year. He probably will try again next year. And he will probably keep trying as long as he is in the Senate and the policy does not suit him.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Transm'ssion line maintenance (1,500-mile line) was 17% cheaper when crews were transported in a second helicopter than when using one helicopter solely for patrol.

Instruments shipped assembled on a panel are probably exposed to rougher handling and more likely to be out of adjustment than if packed and shipped separately.

High-pressure, high-temperature power piping may be packed with sand and bent while cooling to within the 2,000-1,400 F range.

Anodic corrosion of lead sheaths results from the rectification of low ac voltages induced in the sheath by the load currents in the cable conductors.

Ethylene glycol terephthalate films of 0.001-in. or less thickness reportedly show a short-time electric strength of better than 4 kv/mil.

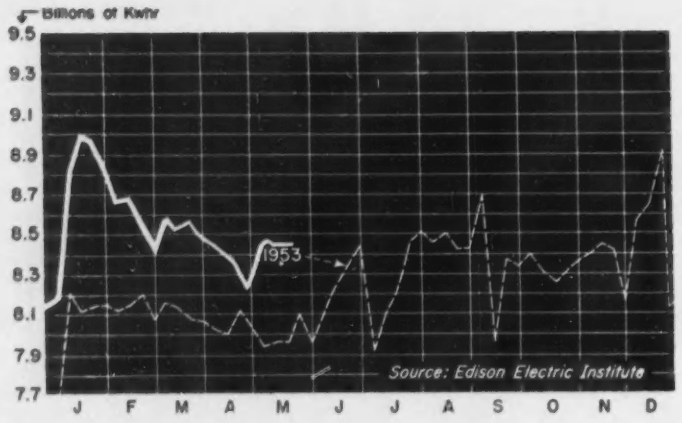
Tension sleeves installed for emergency repairs of transmission conductors may be likely to slip in case ice and wind set up a dancing condition.

High-temperature turbines stay so warm even for 5 or 7 days after shutdown that introduction of cold water for a hydrostatic test may occasion undesirable stresses and distortions.

Three-conductor 132-kv cables on the British Electricity Authority system operate at 200 psi nitrogen and have an external diameter of 5.07 in.

Everybody in the world stands in an electrostatic field that is vertically gradiented. This field represents a positive potential difference of 200 v from the head down to the feet.

STATISTICS



Output Week Ended May 22—8,373,000,000 Kwhr

Seasonally Adjusted Index†—167.9

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
May 22	+4.5	+3.5	−0.9	−4.2	+8.1	+16.4	+7.9	+6.2	+5.4	+8.3
May 15	+5.3	+2.4	−0.4	−3.2	+7.7	+19.8	+7.9	+6.4	+7.3	+5.7
May 8	+6.9	+5.2	+0.3	−0.8	+9.3	+19.2	+12.6	+8.2	+9.5	+7.5

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load‡ (Million Kw)	Mar.	74.7	74.9	70.7
Capacity (Million Kw)	Feb.	92.46	91.68	82.83
Production (Billion Kwhr)	Mar.	38.92	35.21	36.97
Hydro	Mar.	9.92	8.56	10.20
Fuel	Mar.	29.00	26.65	26.77
Fuel Consumption				
Coal (Million Tons)	Mar.	9.89	9.07	9.44
Oil (Million Barrels)	Mar.	6.46	5.70	8.08
Gas (Billion Cu Ft)	Mar.	78.23	75.74	70.16
Sales (Billion Kwhr)	Mar.	32.53	32.37	31.73
Residential	Mar.	10.15	10.50	9.10
Commercial	Mar.	5.60	5.60	5.18
Industrial	Mar.	14.67	14.21	15.36
Other	Mar.	2.10	2.05	2.09
Net Income Class A & B Companies ($ Million)	Mar.	94.29	111.85	91.64
Estimated Dec. '54 Peak‡ (Million Kw)	Mar.	88.5	88.8	92.1
Kwhr per Residential Customer (12 Month Average)	Feb.	2,382	2,363	2,198
Revenue per Kwhr Residential Service (12 Month Average)	Feb.	2.73¢	2.74¢	2.76¢
Canadian Production (Billion Kwhr)	Mar.	5.77	5.15	5.78

Business Statistics

FRB Industrial Production Index†	Apr.	123	125	136
Gross National Production Annual Rate ($ Billion)	IstQtr	358.5	363.5	363.9
EW 4 Industry Production Index†	Apr.	115.1	116.7	126.5
ENR Construction Cost Index††	Apr.	129.0	128.7	123.6
BLS Consumer's Price Index	Apr.	114.6	114.8	113.7
NEMA Insulation Materials Sales Index†	Mar.	136	120	190
NEMA Electric Appliance Sales Index†	Mar.	105	98	140
NEMA Household Refrig. Sales Index†	Mar.	89	91	108
Metal Prices (May 25)				
Copper, Conn., V., lb		.30	.29¾	.29¾
Lead, N. Y., lb		.14	.14	.13
Zinc, prime Western E. St. Louis, lb		.10¼	.10¼	.11
Tin, Straits, qual. N. Y. lb		.93½	.97¾	.97¼
Aluminum, ingot, base price		.21½	.21½	.20½
Nickel, base price		.60	.60	.60
Steel, billets, Pitts., ton		62.00	62.00	59.00
Steel, scrap, No. 1 heavy, Pitts., ton		30.00	27.00	44.00

*Preliminary **Revised ‡Class I Systems †1947-49=100 ††1949=100

Power Pool Prophecies: 476,155 million Kwhr in '54

Load growth for this year will be 7.7% above 1953 and total generation will be 476,155 million kwhr. Those are the averages of the estimates of the 373 participants in the 1954 Kwhr Power Generation Pool, conducted by Bob Hatfield of Combustion Engineering, Inc. Represented this year are 102 different utilities located in 40 states, plus 34 consulting engineers and 32 equipment manufacturers.

Guesses range from a gloomy prediction of 441,684 million kwhr—slightly under 1953's total of 442,285 million, to the optimistic figure of 550,400 million kwhr, which would mean a 20% load growth.

When the guesses are sorted according to Federal Power Commission power supply areas, it turns out that Region III, the Southeast, is closest to the national average with a figure of 476,468 million kwhr. The most

Region	Average (Million Kwhr)
I Northeast	475,053
II East Central	472,966
III Southeast	476,836
IV North Central	476,836
V South Central	482,301
VI West Central	477,398
VII Northwest	480,296
VIII Southwest	476,793

sanguine prediction, for the third straight year, stems from the South Central Supply area with an average forecast of 482,301 million kwhr, or load growth of over 9%. The fact that most of the 40 crystal-ball-gazers in this area are Texans might have something to do with the cheerful outlook.

On the other hand, the heavy industrial areas of Ohio, Indiana, Michigan and Pennsylvania, etc., which make up the East Central Supply Area, are predicting a load growth of only 7%, a rather pessimistic figure when you consider that last year's load growth of over 10% was due in part to the heavy power consumption in that area. The drop in automobile and steel production of course is unquestionably a strong factor in the current estimates.

The guesses of the 41 utility presidents participating in this year's contest average to 475,061 million kwhr, while 14 women participants this year predict the more optimistic average of 480,936 million kwhr.

FINANCIAL

No Forced Obsolescence . . .

. . . of present generating equipment because of nuclear power is likely, Detroit Edison's Comptroller E. H. Scott reports

Forced obsolescence of present generating equipment because of the introduction of nuclear power is not likely to become a major factor, Eldred H. Scott, comptroller, Detroit Edison Co, told an atomic energy forum at the convention of the National Federation of Financial Analysts Societies at the Palmer House, Chicago, recently.

He predicted that the growth in consumption of electricity has been so rapid that there has been little opportunity in the past to retire older equipment, and nuclear equipment also can be introduced in an orderly manner.

No Large Write-Offs of Property . . . Regulatory precedents established in the natural gas and telephone industries should allay any fears as to the ability of most electric utility companies to recover from customers any large write-offs of property occasioned by the use of nuclear fuel, Detroit Edison's comptroller declared.

He pointed out that atomic or nuclear power will have little effect on the electricity bill of residential and commercial users, and the impact, if any, on the value of electric utility company shares will be favorable.

The benefits of atomic energy, he said, have been oversold to the American public. Electricity is about the cheapest thing in the family budget today, and most of the cost to the domestic and commercial consumer reflects transmission, distribution, and customer service expenses, which will not be affected by the use of nuclear energy, he said.

Nuclear Power New Form of Fuel . . . "Nuclear power will merely provide a new form of fuel," Scott explained and "The reactor can replace only the boiler portion of thermal generating stations. The turbo-generator, transmission, and distribution systems will still be necessary." Even the complete elimination of all fuel costs would reduce the cost of only about 14%, the Detroit Edison executive said.

The only threat to the safety of outstanding public utility securities is government competition, Scott declared. Overselling of the benefits of nuclear power has tended to hurt the possibilities of a revision of the Atomic Energy Act favoring development by private enterprise.

Sooner or later, Scott warned, the production of electricity by fissionable material will have to be turned over to private enterprise on a licensing basis if the United States is to have a dynamic technology for a well-balanced economy.

New England Utility's Billing System Attacked

A new system of the Western Massachusetts Electric Co, Springfield, Mass., for billing its electric power customers every other month was attacked recently by State Rep John F. Thompson, Ludlow Democrat, and defended by a company official.

Thompson, who threatened to demand a public investigation, charged that the new billing system will mean more unemployment because the staff of meter readers and clerical helpers can be cut in half at great savings to the company. He also contended the system will work a hardship on the consumer forced to pay a bill twice as large out of his weekly pay. The large cut in costs to the company, he argued, should be reflected in a reduction of rates to the consumer.

The company Manager Wesley L. Mitchell replied that the company "does not expect to let anyone go. But one or two employees may be displaced into other departments."

In answering Thompson's second charge, he said arrangements had been made for the consumer to pay his bill every month if so desired. The bills will cover a two-month period but half may be paid at a time.

He said the company instituted the new billing system for the Springfield section "in order to avoid additional increases and to take every measure to hold costs down."

Thompson asserted that once again the utilities are coming "to show another disregard for the public. In this plan of a new billing procedure, they are showing selfish consideration at the expense of the consumer."

Citing a 1952 decision of the State Department of Public Utilities which gave the company an $800,000 a year rate increase, Thompson said: "Apparently the huge sum was not enough. In small print in this same agreement (the company) reserved the right to bill every other month."

Mitchell said that both the company and the consumer will benefit by savings under the new system. Estimating that the bi-monthly billing would save the consumer "as much as $1 per year," he explained this will be saved in transportation costs to bill payment places or in check payments, each of which will be cut in half.

"The system has been in effect for some time outside of Springfield," Mitchell said. "We have had experience with it and are pleased with the results. We owe it to our customers to effect savings for the customer wherever possible."

FPC Approves Merger of Pacific P&L, MSP

Pacific Power & Light and Mountain States Power companies have merged as of May 21. They have announced prorated dividends to be paid stockholders on the basis of previous announced plans to co-ordinate dividend schedules. Announcement of the May 21 date followed Federal Power Commission approval of the merger.

Stockholders of record May 21 will be paid today, May 31, under authority of director action at the last meeting. Pacific will pay 19½¢ per share on the common and 28½¢ a share on the preferred. Mountain States will pay 12¢ on the common and 35¼¢ on the preferred.

The board of the merged company will then be in position to consider payments of a second partial dividend

to cover the period from May 21 to June 30. After that the dividend action of Pacific P&L will be considered at regular quarterly intervals on a schedule formerly maintained by Mountain States.

Exempted From All Taxes

Bogota, Columbia (McGraw-Hill World News)—The Columbian Government has exempted private electric utilities from the payment of all municipal and state taxes. It is expected that this move will encourage private investments in the private electric utility field and speed up the electrification of rural areas and small towns. At the same time Ministerio de Fomento has loaned 21.5 million pesos ($8.6 million) to country's electric projects. The largest is to go to Central Electrica de Anchicaya for 6.5 million pesos ($2.6 million).

Georgia Power Squabble May 'Die of Old Age'

Legal entanglements involving Georgia Power Co., Georgia Power & Light Co, Florida Power Corp, and the Georgia Public Service Commission may die of old age before an adjudication is reached. That's the way it looked recently as the Georgia Power & Light Co returned to its Nov. 15, 1953, rate structure, thus wiping out the original cause of complaints.

Last fall, Georgia P&L, a subsidiary of the Florida Power Corp, which services some 35 south Georgia cities and towns, asked for and got a rate increase estimated to provide the company an additional $124,000 per year. Company was given a six months' temporary increase which expired on May 15. The trouble, however, started in November. Customers—particularly industrial users—complained that the rates were too high and that Georgia Power Co was servicing its customers across county lines with lower cost power.

Georgia P&L told the commission that the rate increase was needed as its costs of production of power had increased materially. So the commission suggested that the company look around for a cheaper source of power

(*Continued on page* 158)

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1954									
May 20	**2.86**	**2.91**	**3.14**	**4.02**	**4.15**	**4.46**	**4.70**	**5.19**	**5.44**
May 13	2.85	2.91	3.14	4.02	4.14	4.45	4.75	5.19	5.48
END OF QTR									
1st 1954	2.82	2.87	3.14	3.88	4.09	4.42	4.83	5.19	5.42
4th 1953	3.07	3.12	3.34	4.17	4.32	4.62	5.07	5.57	5.51
3rd 1953	3.20	3.33	3.54	4.35	4.52	4.83	5.36	5.97	6.01
2nd 1953	3.34	3.46	3.64	4.47	4.70	4.88	5.52	5.93	6.10

Data: Reis & Chandler, Inc.

EARNINGS

Company	Period Months	Ended	Net Income 1954	Net Income 1953	Earnings Per Common Share 1954	Earnings Per Common Share 1953
Cincinnati Gas & Electric	12	Mar.	$11,655,298	$10,583,308	$1.57(a)	$1.48(a)
Cleveland Electric Illuminating Co and subsidiaries	12	Mar.	14,854,838	13,059,310	4.10	3.56
Pacific Gas & Electric	12	Mar.	59,004,589	49,826,061	2.95(b)	2.62(b)
Potomac Electric Power	12	Mar.	6,347,139	6,194,424	1.16(c)	1.13(c)
Washington Water Power	4	April	1,529,779	1,483,108	0.65(f)	0.06(f)
			1953	**1952**	**1953**	**1952**
Frontier Power	12	Dec.	$30,400	$38,100	....	....
Mountain States Power	12	Dec.	1,871,254	1,605,228	$1.35	$1.14
Salt River Agricultural Improvement and Power District	12	Dec.(g)	1,589,792	1,486,500	....	....

Notes—Figures for the last three annual reports have been audited; (a) Based on 6,700,050 shares in 1954 and 6,405,000 shares in 1953 and adjusted on the 2-for-1 stock split which became effective May 4, 1953; (b) Based on average number of shares outstanding during each period; (c) Based on 5,117,040 shares now outstanding; (f) Based on 2,342,411 shares; and (g) Net revenue.

FINANCING

Company and Description	Amount of Offering (000)	Offering Price	Yield to Public
WEEK OF MAY 21-26			
Bonds			
California Electric Power—1st mtg 3¼% due 1984	$8,000	100.95%	3.20%
Public Service Electric & Gas—1st mtg 3¼% due 1984	50,000	102.915	3.10
Preferred Stock			
Florida Power Corp—75,000 4.40% $100 par cum	7,500	$100.000	4.40%
SCHEDULE FOR JUNE-JULY			
Bonds			**Bid Date**
Consumers Power—1st mtg due 1984	$25,000	.....	June 2
Southwestern Gas & Electric—1st mtg due 1984	10,000	.....	June 8
Salt River Project Agricultural & Improvement District, Ariz.—bonds due 1960-82	3,500	.....	June 8
Gulf States Utilities—1st mtg due 1984	24,000	.....	June 15
Jersey Central Power & Light—1st mtg due 1984	6,000	.....	June 15
Central Illinois Public Service—1st mtg due 1984	5,000	.....	June 15
Gulf Power—1st mtg due 1984	10,000	.....	June 22
Duquesne Light—1st mtg due 1984	16,000	.....	June 29
Consolidated Edison Co of N. Y.—1st mtg due 1984	50,000	.....	.....(f)
Boston Edison—1st mtg due 1984	18,000	.....	.....
Preferred Stock			
Gulf States Utilities—160,000 sh $100 par	$16,000	.....	June 7
Duquesne Light—120,000 sh $50 par	6,000	.....	June 23
Public Service Co of New Hampshire—about 75,000	7,500	.....	.....
California Electric Power—105,000 sh $50 par	5,250	.....	.....(b)
Connecticut Light & Power—200,000 sh	10,000	.....	.....
Missouri Public Service—50,000 sh $100 par	5,000	.....	.....(a)
Southern Utah Power—3,224 sh 5% $100 par (1,224 shs to be exchanged for a like amount of 4¼% now outstanding and balance of 2,000 shs to be sold privately)	322	.....	.....
Southern Nevada Power—250,000 shs (company will sell 50,000 shs and balance of 200,000 will be acquired by the underwriters from certain selling stockholders)	.....	.....	.....(e)
Central Maine Power—50,423 shs $100 par convertible (to be offered commonholders on the basis of 1-for-50 and the 6% preferred stockholders on a 1-for-10 basis, record about June 3 to expire June 14)	5,042	.....	.....(e)
Common Stock			
Philadelphia Electric—944,952 shs (to be offered commonholders on 1-for-12 basis, record June 7, to expire June 28)	.....	.....	.....
Hilo Electric Light—25,000 sh (to be offered commonholders on 1-for-4 basis, record June 5 to expire)	$500	$20.00	8.00%
Long Island Lighting—600,062 sh (to be offered commonholders on 1-for-8 basis unsubscribed sh to be sold to underwriters; 64,585 sh to be offered to employees)	.....	.....	.....
Connecticut Light & Power—590,290 sh (to be offered commonholders on a 1-for-10 basis)	.....	.....	.....
Southern Utah Power—13,135 sh (to be offered commonholders on a 1-for-6 basis)	.....	.....	.....

Notes—(a) Postponed indefinitely; Kidder Peabody & Co, underwriters; (b) Temporarily postponed; Merrill Lynch, Pierce, Fenner & Beane, group, underwriters. (c) William R. Staats & Co group, underwriters; (e) Harriman Ripley & Co, First Boston Corp, and Coffin & Burr group, underwriters; and (f) Temporarily postponed.

General Electric opens $25 million Rome, Ga., plant to build you better power transformers . . . faster

There's a brand new kind of plant today in the heart of the booming South. It's General Electric's giant Medium Transformer Plant just completed at Rome, Georgia . . . to mass-produce power transformers designed in accordance with ASA Standards.

The cost-conscious electric utility industry's acceptance of the RM (Repetitive Manufacture) idea accented the need for this new plant. In six years, shipments of standardized units by General Electric have jumped 59 percent. What's more, this trend is growing even stronger—utility after utility is expressing preference for RM-ASA transformers because their price is less, by up to 8%, and they can be delivered months sooner.

Bigger and better manufacturing facilities were needed to meet this swing. The new General Electric plant at Rome, Georgia, is the result. It has been planned, designed, and built with one purpose: to make the finest transformers in the fastest, most efficient way. To get an idea of how G.E.'s brand new plant mass-produces RM-ASA medium transformers, just turn the page and take an armchair tour . . .

(422-9)

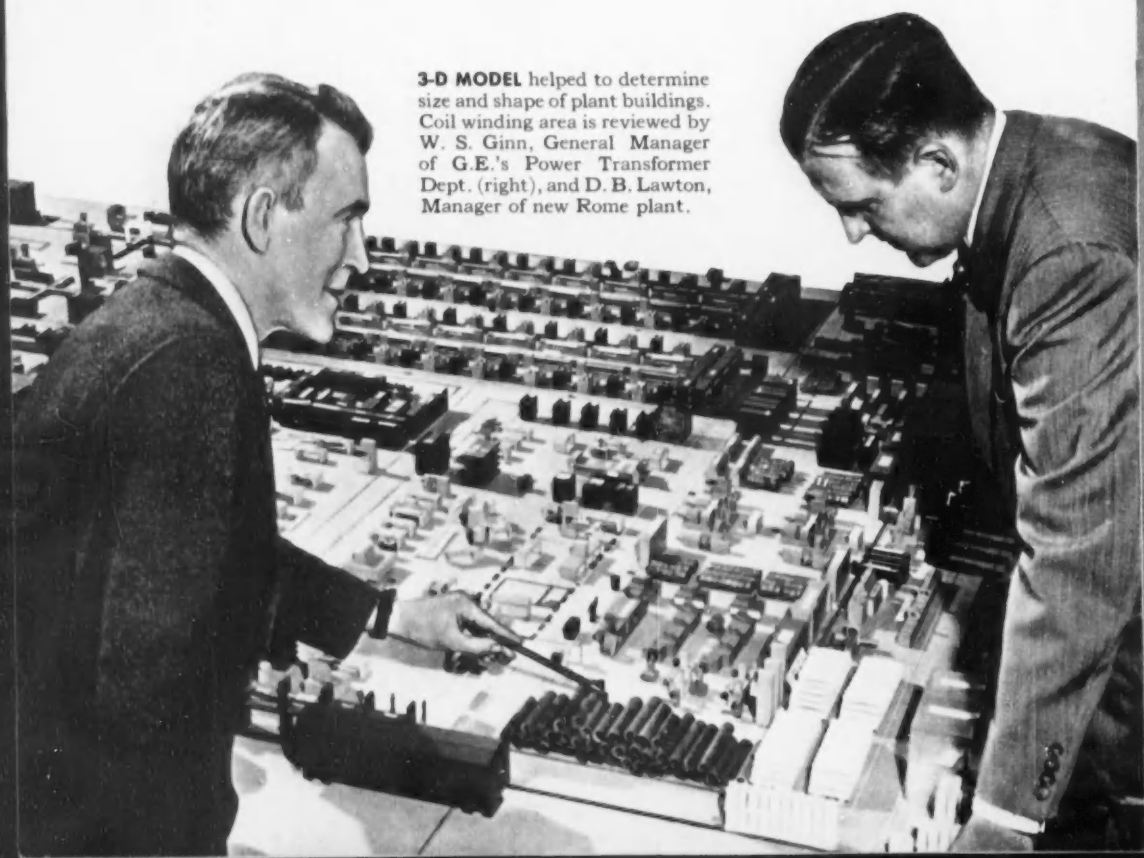
GENERAL ELECTRIC

Mechanized material flow, new processes produce your G-E transformers when you need them

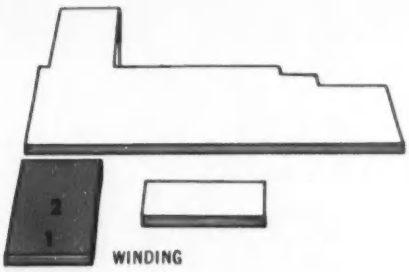
At the very start, the men who planned General Electric's new Rome plant were handed a simple challenge: to create the finest possible facility for making high-quality standard-design transformers in the shortest possible manufacturing time.

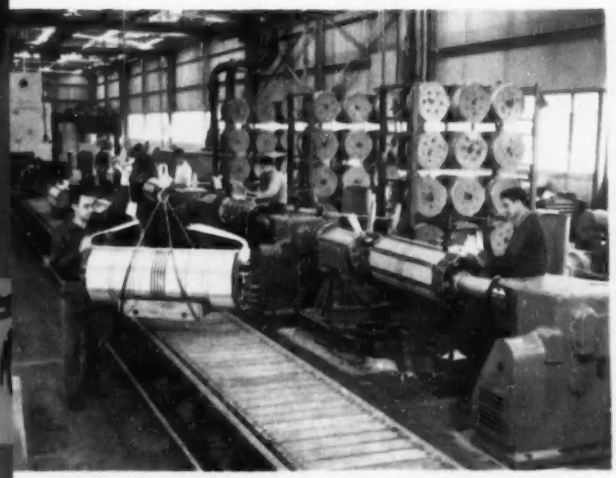
They did their planning carefully. First, they figured out how each manufacturing step could be performed best, taking advantage of new processes and modern materials handling methods. Next, they designed the plant area to match the work needed for each step. Then they blended all of these operating steps—set up a continuous manufacturing process, with all material following a smooth, in-line flow.

These General Electric planning engineers had no preconceived plant shape or area to tie them down. Instead, they worked out, with seasoned production men and transformer engineers, the most efficient repetitive manufacturing facility for transformers in the country today. The result is more than just a new, fast-moving, high-output plant. It is a way of giving you RM-ASA transformers of the most modern design and built to exacting quality standards . . . *when* you need them. General Electric Company, Schenectady 5, New York.

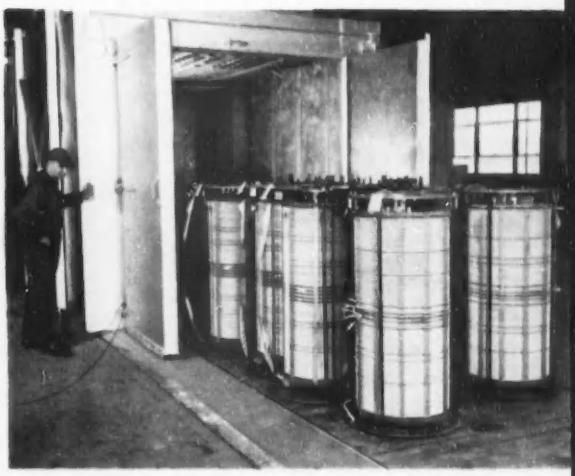


3-D MODEL helped to determine size and shape of plant buildings. Coil winding area is reviewed by W. S. Ginn, General Manager of G.E.'s Power Transformer Dept. (right), and D. B. Lawton, Manager of new Rome plant.

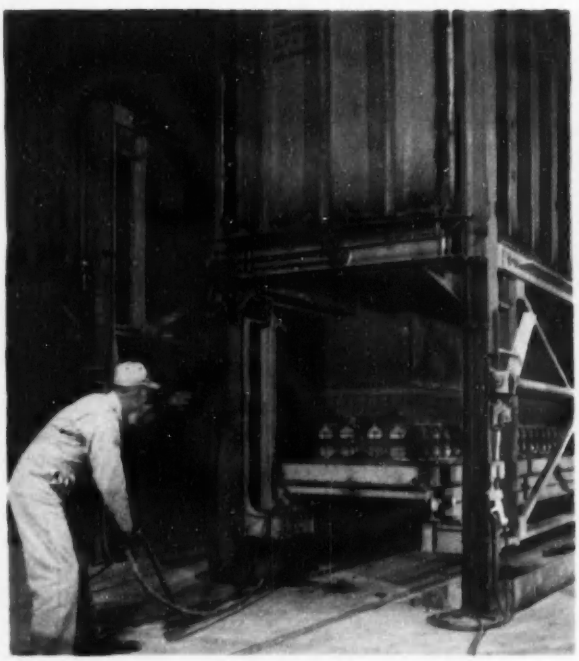




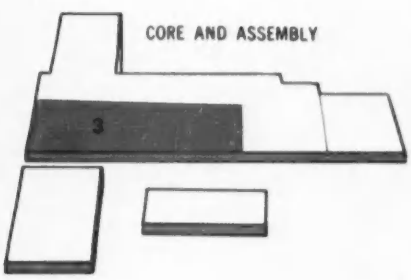
1. Banks of precision winding machines flank both sides of moving conveyor. Overhead crane lifts completed coil onto conveyor, which moves toward drying oven (rear).

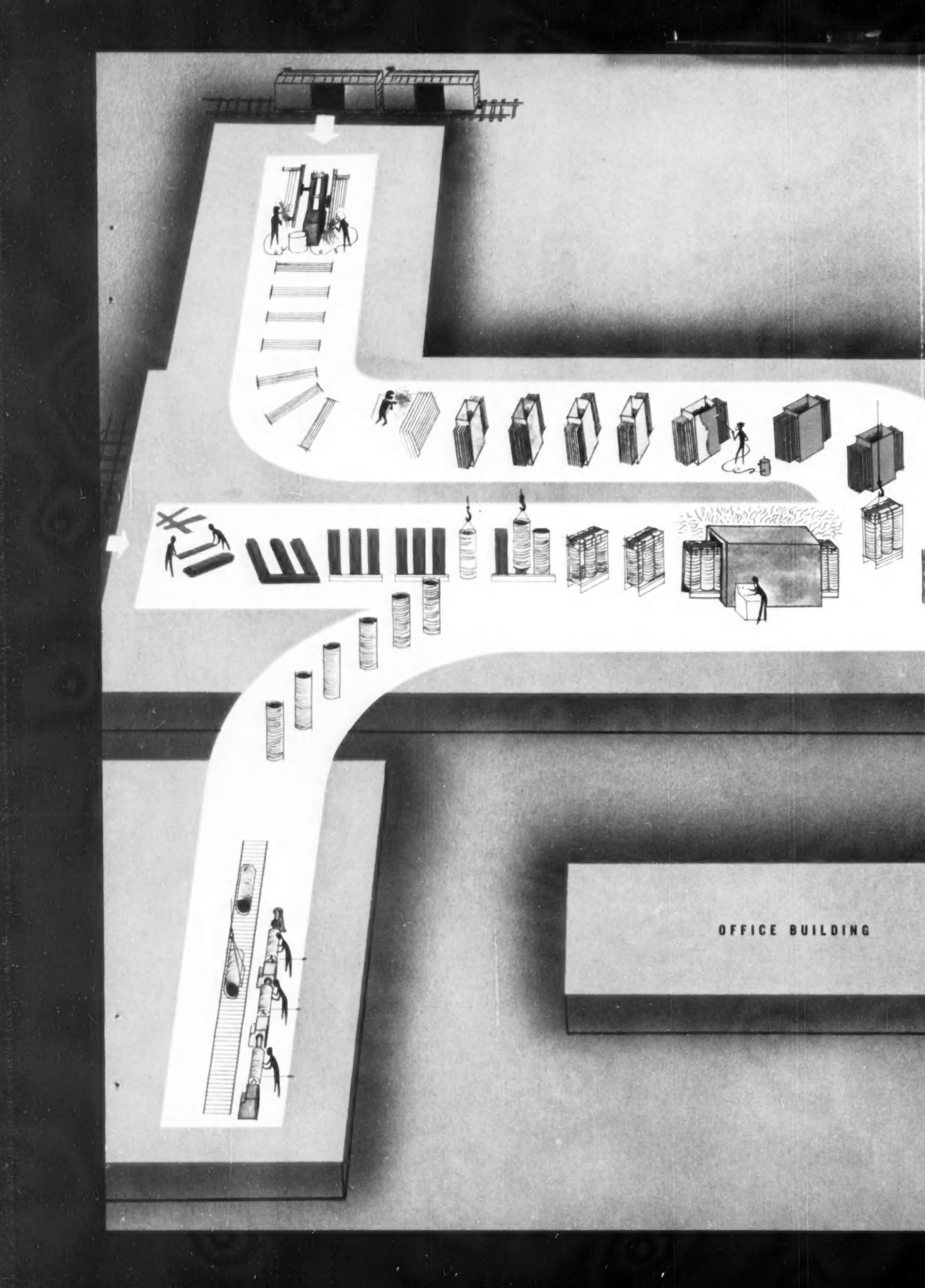


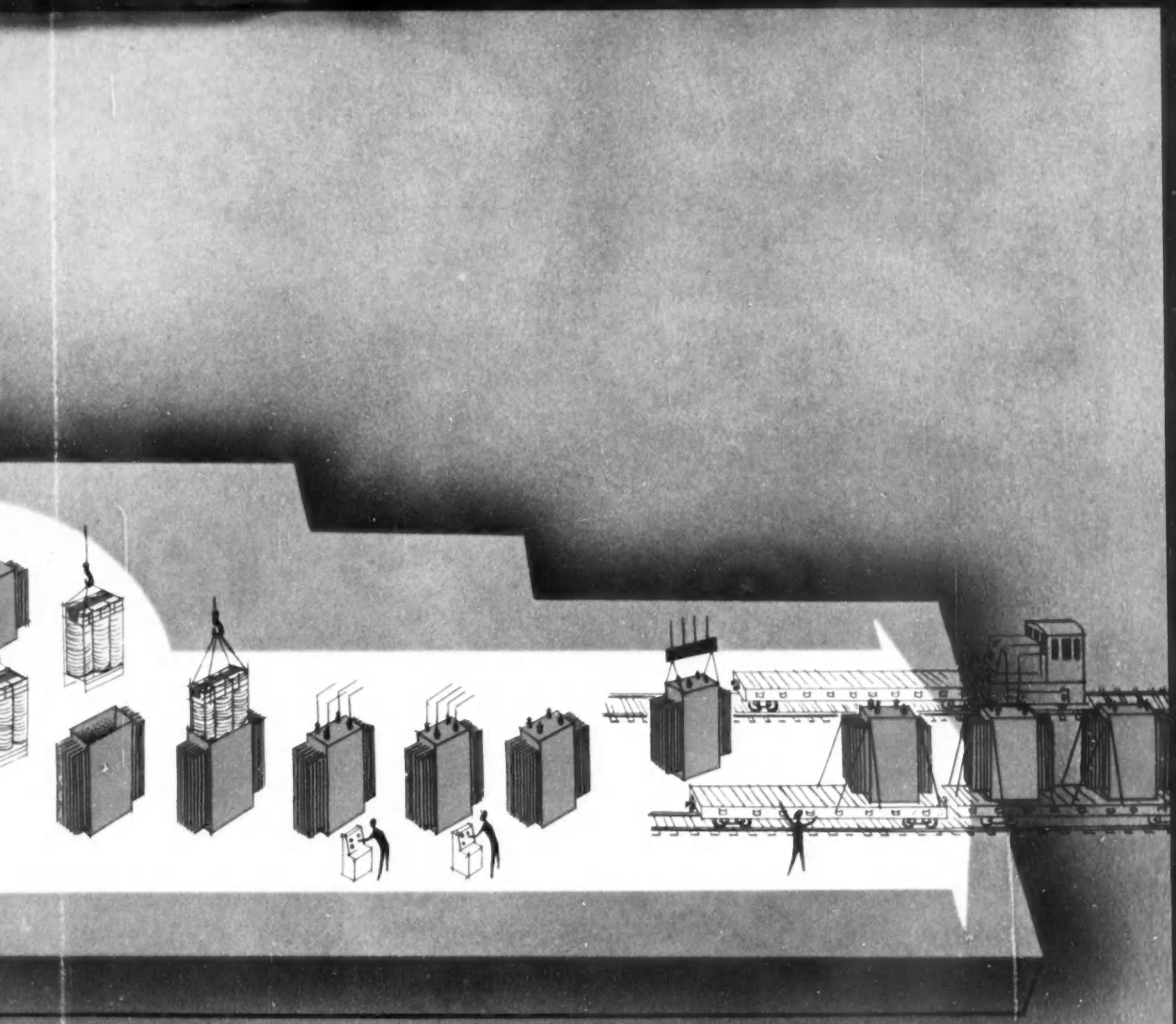
2. "Moving sidewalk" conveyor carries coils into oven, where they will be dried for about 12 hours. All along the line, mechanized handling speeds production.



3. Meanwhile, the core is prepared by cutting, stacking, and then annealing steel in an oven to improve its electrical quality. Steel is cherry red when it leaves the oven for cooling.




OFFICE BUILDING



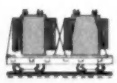
RAW MATERIALS enter plant at point nearest which they will be used

COILS are wound, dried, tested, then taken to assembly area by conveyor

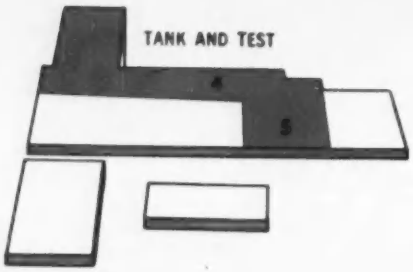
CORES are cut, annealed, stacked, then set on conveyor for assembly with coils

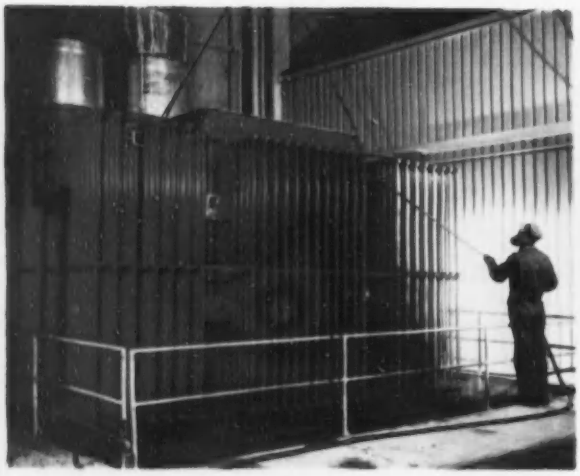
TANKS are fabricated, painted and baked, then conveyed to assembly bay

ASSEMBLED TRANSFORMER moves through successive test berths on dragline conveyor

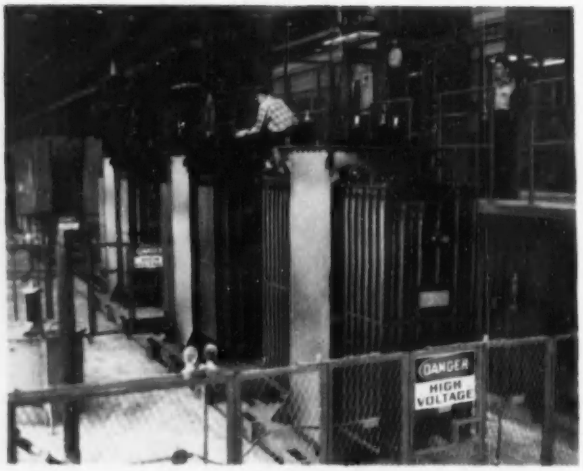


LOADED ON FLATCARS, transformers are shipped to electric utilities and industrials across the nation



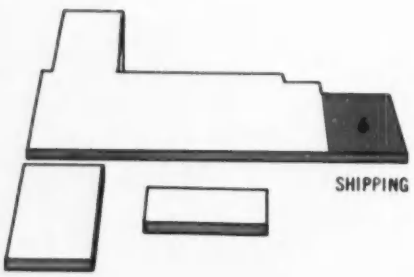


4. Tanks are flow-painted in booths specially designed with overhead conveyors, which also bring them to conveyorized baking oven after each coat of paint is applied.



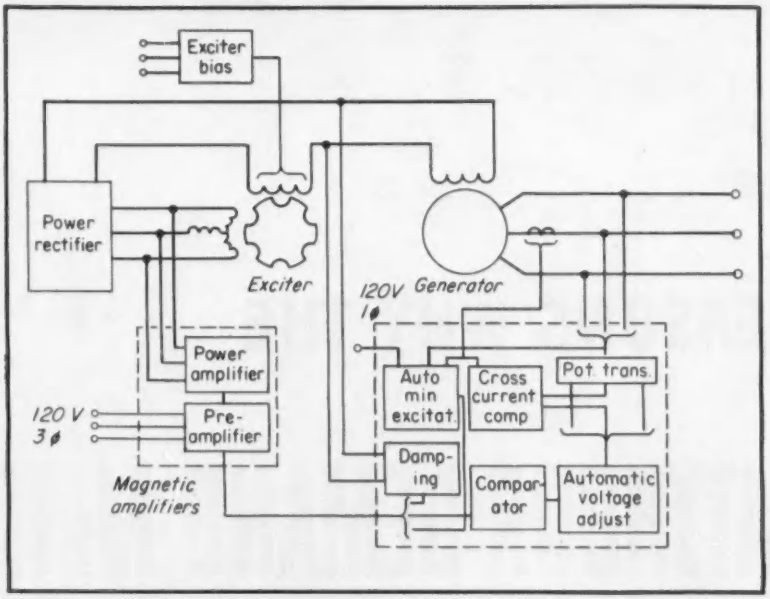
5. After core-and-coils are put in tank, transformer moves to test area. Dragline conveyor moves transformers to successive stations for series of production tests.

6. On their way to locations across the country are some of the RM-ASA transformers built at Rome.



Progress is our most important product

GENERAL ELECTRIC



EXCITER GENERATES POWER at 360 cycles, and ac current is converted to dc by selenium rectifiers. Smaller control equipment is required for the 360-cycle frequency

Excitation System Developed for Large Generators

A new excitation system which uses a 360-cycle inductor-type alternator has been developed by Allis-Chalmers Manufacturing Co. The new exciter has no commutator and no slip rings and is expected to require virtually no maintenance. There are no coils on the rotor.

Speed of response and the ability to build an exciter to operate at 3,600 rpm for the large supercharged machines now being designed, and anticipated for the future, are features of the new design. The new exciter in effect has no time constant in the circuit in which it is used. Rapid voltage changes are accomplished primarily by changes in the ac magnetic amplifier current rather than by changes in the dc exciter field current.

The new excitation system, rated 110 kw at 250 v dc, was initially developed for application to an existing 43,750-kva, 3,600 rpm machine at the Iowa Power & Light Co (EW, April 19, p. 216). It was tested on a shop test generator with substantially the same field resistance and excitation requirements.

Basic Circuit . . . The three-phase, 360-cycle output of the exciter is converted to dc by a selenium rectifier connected in a three-phase bridge circuit supplying the main generator field and the exciter field in series. The exciter field is designed to produce the maximum output needed, while at less than maximum output an excess of field ampere-turns is available. Magnetic amplifiers control the system by absorbing from the ac exciter just enough reactive kva to offset the extra field ampere-turns for a particular operating condition.

Initial build-up of voltage depends on residual magnetism. To insure voltage build-up, regardless of residual magnetism, a bias circuit, which consumes approximately 50 w, is used.

Exciter and exciter equipment are enclosed in a housing at the end of the main generator. Ventilating air is circulated by a centrifugal fan mounted on the end of the exciter rotor. Control equipment is mounted in a small cubicle

Ac Exciter . . . The heteropolar-type of inductor alternator has a rotor which consists of a stack of ring laminations with six integral pole projections. The rotor is overhung on the main generator shaft by means of a bolted connection, eliminating the usual exciter bearings and coupling. However, exciters in higher capacities will be direct-coupled and have bearings.

The stator makes use of a standard induction motor frame and core provided with a 12-pole, three-phase winding with some coils omitted to allow space for a 4-pole dc winding with concentric coils. Voltage is induced in the three-phase winding by the flux variation caused by rotation of the rotor in the 4-pole dc field.

High reactance inherent in this type of machine reduces the amount of magnetic amplifier current necessary to produce a given change in terminal voltage. Changes in magnetization are accomplished primarily by means of the magnetic amplifiers which are capable of very rapid changes in current. This is immediately reflected in the exciter voltage.

The series connection for the exciter field results in an immediate change in dc magnetization in the event of a sudden load change on the main generator because of the induced field current associated with the sudden load change.

Magnetic amplifiers, used as the power amplifier and pre-amplifier for control of the ac exciter, are of the self-saturated type. Control equipment is of the same type as that furnished in the past on rotating-amplifier voltage regulator installations.

Transient Performance . . . Tests of the new excitation system with a 40,000-kva generator have shown extremely rapid initial response. The test generator has an open circuit time constant of 10 sec. With sudden application of approximately 45% load at 20% pf above no load the terminal voltage was restored to its initial value in slightly less than 40 cycles.

Voltage across the generator field reached a ceiling of five times its initial value within 8 cycles after load application. Generator field current reached the required value to sustain the load at the initial voltage in 25 cycles after load application.

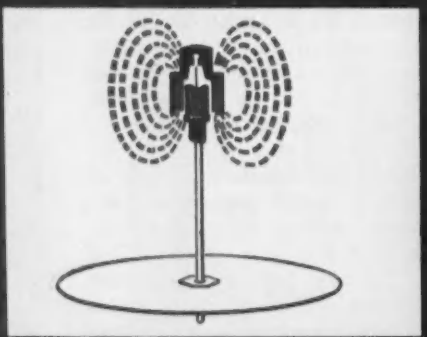
(*More How To on page* 92)

Another member of the I-50 family

6 REASONS WHY THE

G-E IM-50 WATTHOUR DEMAND METER*

WILL LOWER YOUR METERING COSTS



1 **MAGNETIC SUSPENSION SYSTEM** eliminates bearing wear, keeps maintenance costs to minimum; one of many I-50 features in G.E.'s IM-50 meter.

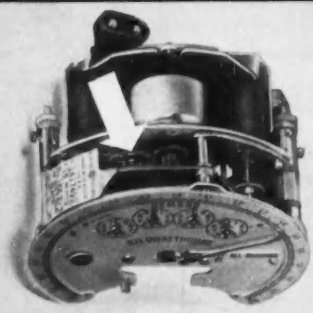
2 **LONG LIFE** of Telechron** motor (arrow) reduces troublesome maintenance problems and need for replacement; grease-lubrication results in longer life of rotor and unit.

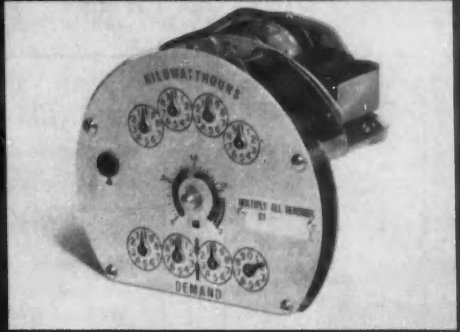
3 **QUICK, EASY RESETTING** is possible with reset mechanism (M-30 register shown). Both indicating and cumulative demand registers are available.

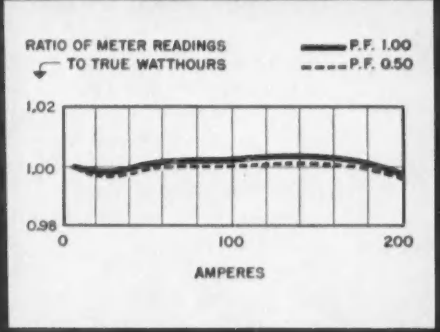
* **IM-50 WATTHOUR DEMAND METERS** are available at 2.5-ampere, 15-ampere, or 50-ampere ratings, for socket or front connections. For a sample demonstration or more information, contact your nearest G-E representative or write Section 601-104, General Electric, Schenectady 5, N. Y.

**Reg. Trade-mark of General Electric Company.

ANOTHER MEMBER of the General Electric I-50 family, the IM-50 watthour demand meter combines moderate price with low installation cost for measuring demand on small commercial and industrial loads. The IM-50 offers high accuracy comparable to the 15-amp I-50.





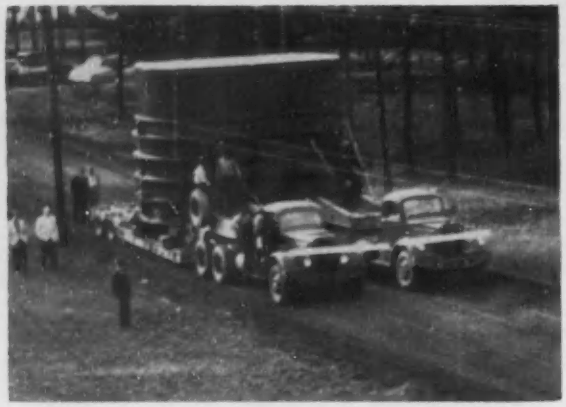


4 **M-30 INDICATING REGISTER** offers greatest flexibility for indicating demand measurements; Geneva action (arrow) assures positive reset.

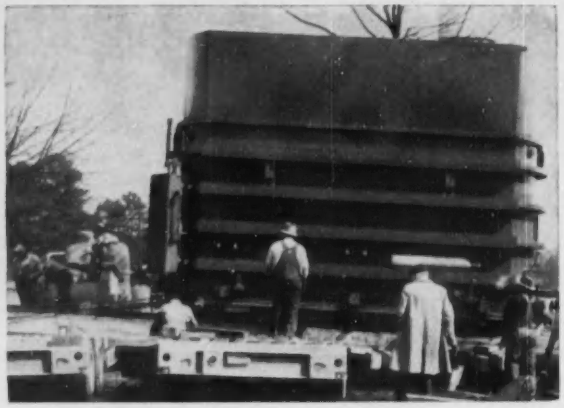
5 **M-31 CUMULATIVE REGISTER** indicates maximum demand plus cumulative value of previous demand; the monthly resetting feature provides accurate, time-saving settings.

6 **NEW 50-AMPERE RATING** extends straight-line accuracy up to 200 amperes, thus increases dependability of meter on small and large loads.

GENERAL ELECTRIC



INCHING DOWN THE HIGHWAY two trucks running abreast haul giant transformer from railroad siding to station (½ mile) in 18 min



LOADING TRANSFORMER on trailers at railroad siding was accomplished with rollers, 12 x 12-in. timber, blocks, winches, and jacks

Trailer Truck Saves ½-Mile Railroad Siding

J. E. CHAPMAN,
Supt of Electrical Construction and Maintenance, Duke Power Co, Charlotte, N. C.

Moving two large transformers with trailer tractor and trucks at Duke Power Co's Tiger Steam-Electric Station saved the cost of building about ½ mile of railroad track. Although the company had to purchase an additional trailer truck (one trailer truck was already on hand) this will be useful for years on other work.

Moving the 220-ton, 150,000-kva, 230-kv units posed an engineering problem when they reached the railroad siding about half a mile from the point where they were to be installed. The company had three choices: Build a half mile of railroad to the transformer base, roll the units on rollers, or move them by tractor and trailer trucks.

It was decided that the economical and practical way to do the job was with trucks.

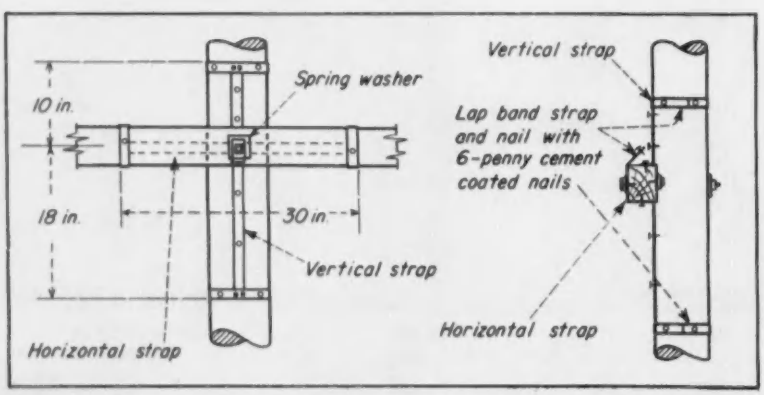
Trailers were lined up side by side and braced with timbers to support the shifting load as the transformer rolled onto the trailers. After the transformer was loaded, the bracing was removed from beneath the trailer, and the transformer was anchored.

Running abreast, the trucks towed the load to the station half a mile away in 18 min, traveling at 1.67 mph. For unloading the loading procedure was reversed—the transformer was eased down 12 x 12-in. timbers from the trailer to the base and the job was done. The second unit was handled the same way.

Straps and Washer Stop Pole-Top Fires

Bonding straps and spring washers are being used by Sierra Pacific Power Co to reduce the incidence of pole-top fires on single-pole, 60-kv lines in very dry areas. On about 110 miles of new construction of this type of line in western Nevada, no fires have been reported to date.

On older lines that experienced pole-top fires, burning usually occurred at the crossarm through bolt or at the lag screw attaching crossarm braces to the pole. The solution incorporates bonding straps to make a metallic connection for the leakage current to pass from the crossarm to the pole. Attachment of straps on pole and crossarm is shown in the accompanying drawing.



GALVANIZED STEEL or aluminum sheet scrap is used to make bonding straps by local sheet metal firms. Center and end bands of straps are spot welded or riveted to form H-shapes

The horizontal piece has a center strap 1½ in. wide and 2½ ft long and two end bands 1 in. wide and 2⅓ ft long. Each end band is attached at a point 6 in. from one of its ends to one end of the center strap. The vertical unit has a center strap 1½ in. wide and 2⅓ ft long and two end bands 1 in. wide and 3 ft long. Ends of the center band are attached

(*Continued on page* 98)

4 reasons why G-E vertical-lift design is best for metal-clad switchgear

1 Allows you to see breaker disconnect

With General Electric's vertical-lift breaker, you can actually *see* that the circuit breaker is disconnected. You don't need to depend on an indicator and when the breaker is disconnected, mechanically operated shutters in metal-clad switchgear automatically close off these stationary disconnect openings to protect the operator.

2 Simple to inspect and maintain

While G-E breaker is still in the compartment, you can make most check tests and even perform some maintenance. Although removal of breaker element is relatively easy, inspection in the compartment saves considerable time and effort.

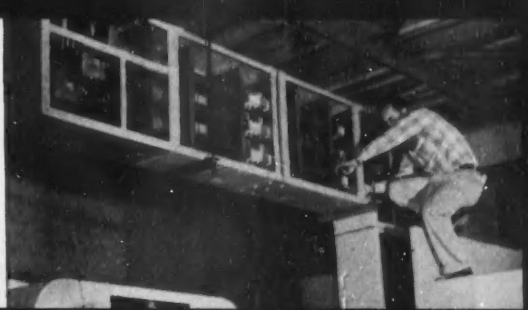
3 Saves time and energy

In G.E.'s vertical lift design air circuit breakers rated 100 MVA and larger are lowered and raised effortlessly by a simple, fast-acting elevating mechanism, consisting of two jack screws and a sturdy, compact gear-motor. You do away with jacking and cranking. Just set switch for "raise" or "lower" and hold clutch lever forward until breaker is in position.

4 Assures maximum safety

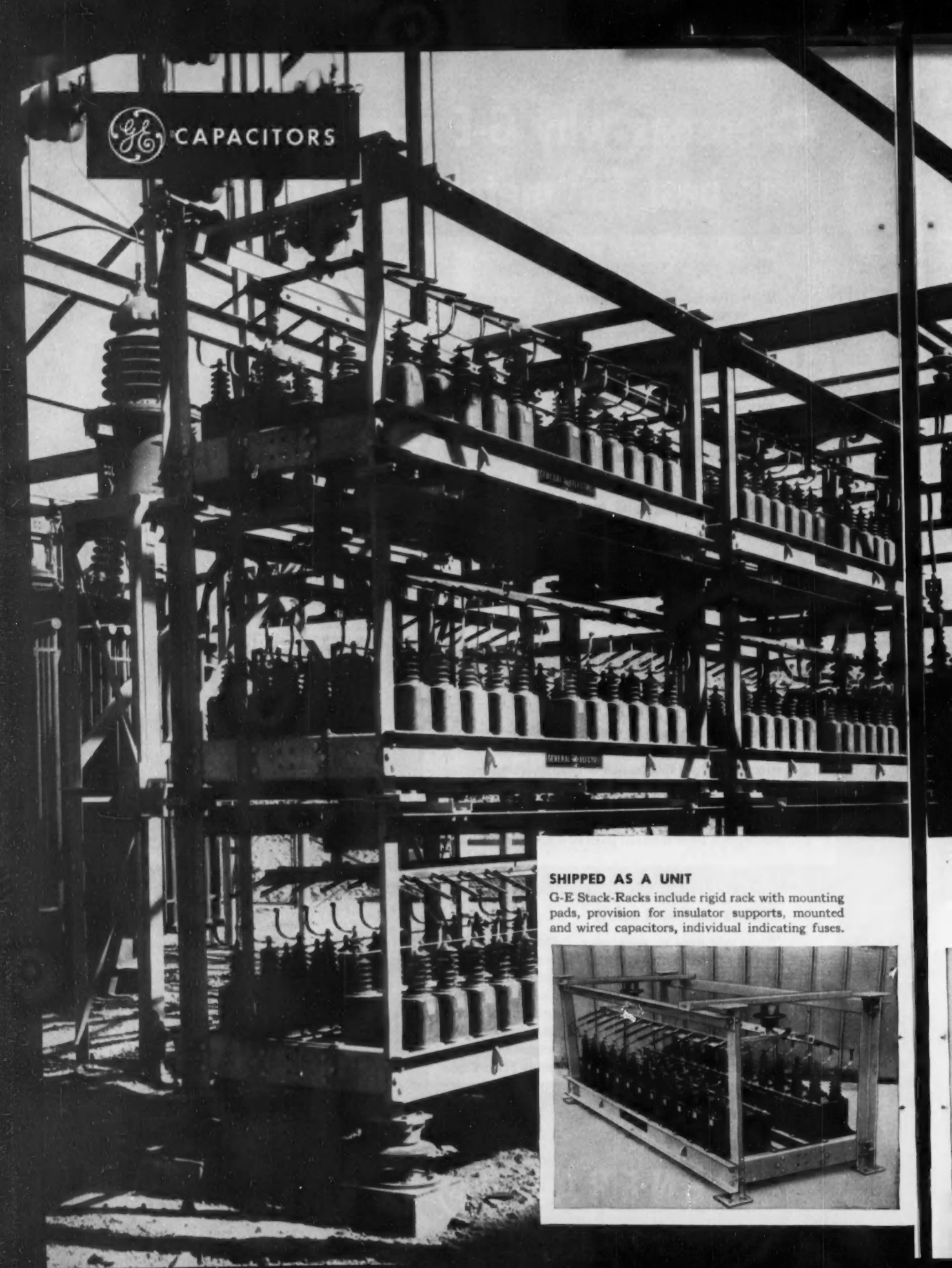
When you need to work on a feeder, you want to be sure that the breaker is disconnected. With G-E vertical lift, you can lower breaker until you *see* contacts disconnect, padlock the mechanism so breaker cannot be raised, and close compartment door. You can then work without fear that someone will carelessly close the breaker and energize the feeder.

General Electric Company, Schenectady 5, N. Y. 511-1



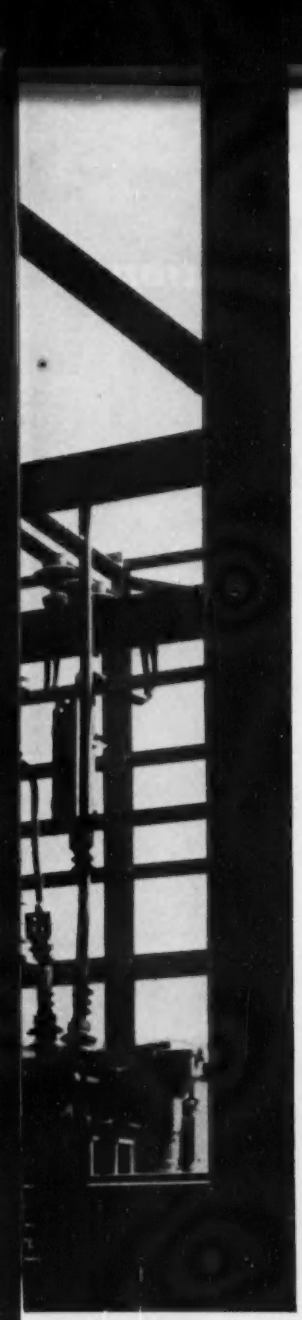
Progress is our most important product

GENERAL ELECTRIC



SHIPPED AS A UNIT

G-E Stack-Racks include rigid rack with mounting pads, provision for insulator supports, mounted and wired capacitors, individual indicating fuses.



G-E Stack-Rack Capacitor Equipment Cuts Installed Costs

Permits "building block" capacitor banks of many kvar and voltage ratings, reduces installation time and costs, is easy to move or add to

High-voltage capacitor banks need no longer be field-assembled single-structure installations. With General Electric's new factory-assembled Stack-Rack capacitor equipment you can install capacitor banks in a wide range of kvar and voltage ratings, faster, at a lower installation cost, and with the flexibility you need to meet load growth and shifts in demand for bulk kilovars.

UP TO 600 KVAR BUILDING BLOCKS. Each single-phase G-E Stack-Rack is a complete unit that includes: (1) a strong, rigid, galvanized steel rack; (2) 10 to 24 units rated 25 kvar, from 2400 to 7960 volts; (3) an all-copper path for both line and neutral bus; (4) indicating, expulsion-type, bus supported fuses for each capacitor; (5) thick, welded mounting pads for stacking racks up to four high; (6) high-strength insulators for base and, when needed, between rack supports; (7) four lifting lugs welded to main supporting channels for hook or cable slings.

BANKS UP TO 330 KV. Open-type Stack-Rack capacitor banks can be supplied for any system voltage 2400 volts and above. Their primary application is on transmission and subtransmission circuits where they minimize installation time and cost. In addition, they have the advantage of permitting assembly on irregular plots and need no provision for fan power. These same advantages are provided for circuits below 15 kv when Stack-Racks are used in place of enclosed equipment.

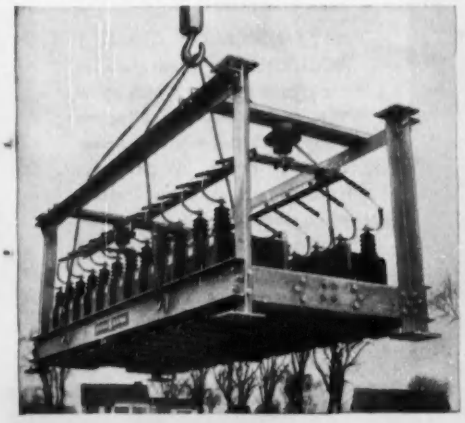
We believe it will pay you to evaluate your present practice on kilovar supply to take advantage of the economy and flexibility of the new G-E Stack-Rack. For complete information see your General Electric Apparatus Sales representative. General Electric Company, Schenectady 5, New York. 441-10

Progress is our most important product

GENERAL ELECTRIC

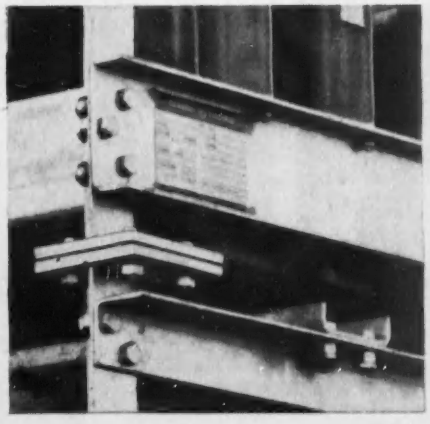
EASY TO HANDLE

Four lifting lugs welded to main supporting channels take either hook or cable slings—units remain in positive alignment.



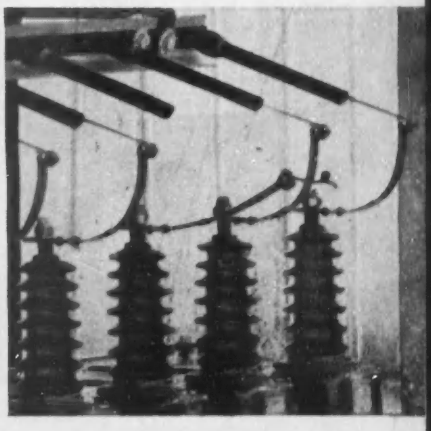
EASY TO INSTALL

Thick welded mounting pads assure flatness and facilitate bolting racks together with or without insulators.



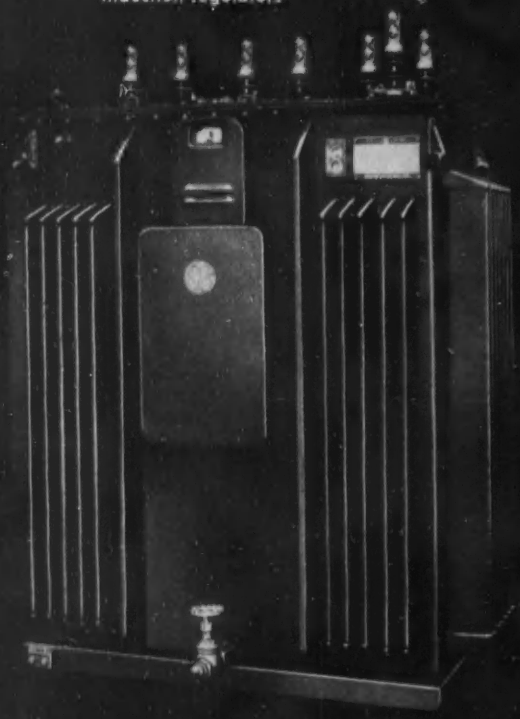
EASY TO INSPECT

Open-type construction and individual indicating fuses permit quick visual inspection—note blown fuse link below.

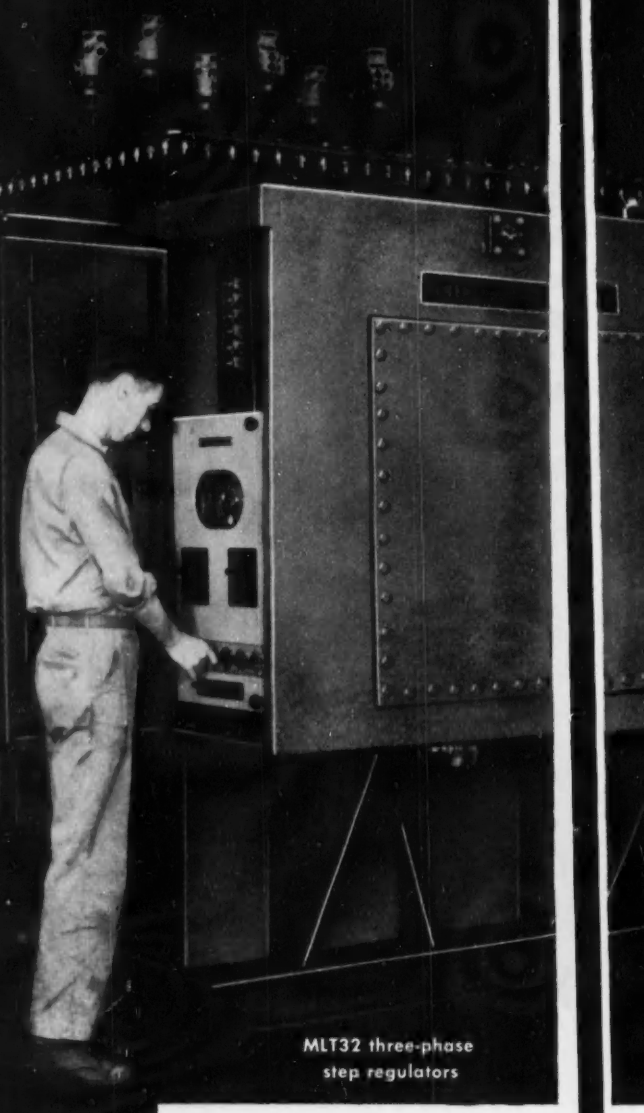


FEEDER VOLTAGE REGULATORS

a complete line of both step and induction



IRT three-phase
induction regulators



MLT32 three-phase
step regulators

IRS single-phase
induction regulators

ML32 single-phase
step regulators

ADVANTAGE OF CLASS 1 ACCURACY is illustrated in diagrams at right which show how a reduction in *effective* bandwidth permits a greater voltage drop in primary, transformer, and secondary while maintaining the same voltage standards from first to last consumer.

regulators with the economy of

Class 1 Accuracy at no extra cost

Whatever your voltage problem, you'll find a dependable, low-cost solution in this complete line of General Electric feeder voltage regulators.

G-E Induction Regulators, available for circuits up to 15 kv and 3000 kva, provide smooth, stepless control and need virtually no maintenance. For close regulation of single-phase feeders where operations are frequent and immediate voltage correction is required, G-E Type IRS single-phase induction voltage regulators offer the finest regulation obtainable. Their rugged operating mechanism and the elimination of switching contacts give you a maintenance record unbeaten anywhere. Type IRT three-phase induction regulators offer the same advantages of rugged construction, long life, and negligible maintenance.

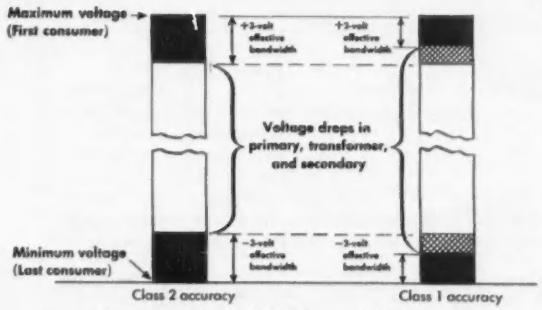
G-E Step Regulators assure dependable and economical regulation where you handle large blocks of power, and where you need supplementary regulation on your branch and rural feeders. For three-phase circuits, station-type MLT32 regulators adjust voltage in thirty-two 5/8% steps (Best suited for lines with balanced loads). They feature accessibility and ease of maintenance of switching mechanism. G-E Type ML32 single-phase step regulators also adjust voltage in thirty-two 5/8% steps, and give low-cost, dependable regulation on branch and rural circuits.

Class 1 Accuracy, the highest accuracy classification defined by ASA Standards, is a standard feature on *all* G-E voltage regulators. When compared with regulators with Class 2 or Class 5 accuracy, the G-E regulator with Class 1 accuracy permits (1) greater feeder length at the same load density, (2) greater load on existing feeders, or (3) higher voltage standards on existing feeders. Insist on Class 1 Accuracy controls. They mean *dollars* in your pocket with not one additional *cent* in investment.

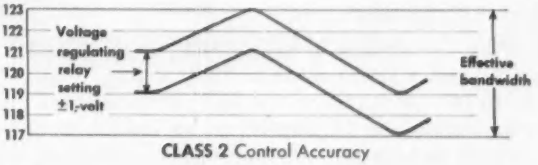
For More Information about G-E voltage regulators, contact your nearest G-E Apparatus Sales Office or authorized agent. Or write Section 423–4, General Electric Company, Schenectady 5, New York.

Progress is our most important product

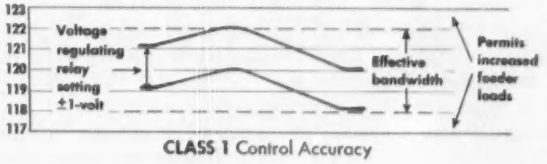
GENERAL ELECTRIC



Decreased effective bandwidth (see cross-hatched area at right) permits increased feeder loads, while maintaining the same voltage standards.



CLASS 2 Control Accuracy



CLASS 1 Control Accuracy

Straps

(*Continued from page* 92)

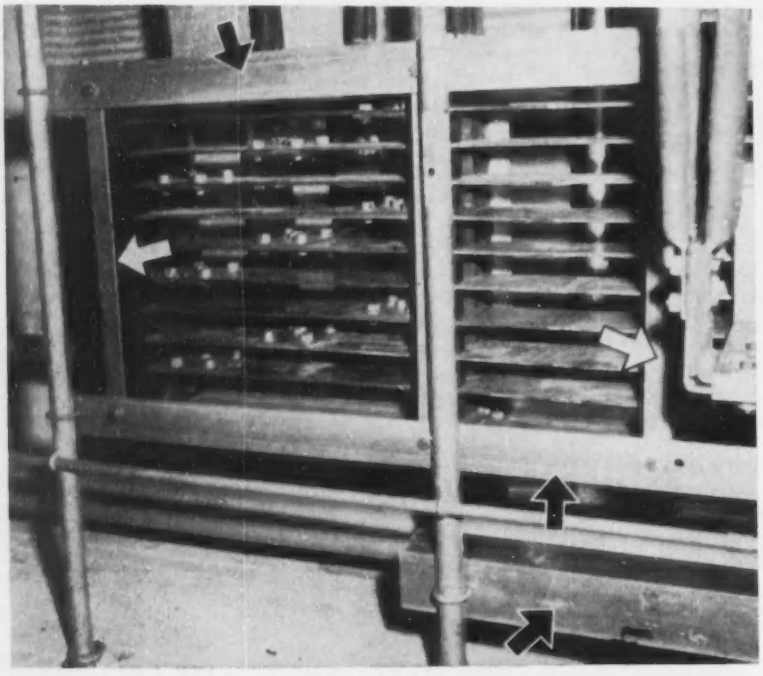
to the center of each end band.

Straps are made by local sheet metal shops of either galvanized steel or aluminum sheet scrap about 26 gage. Straps are riveted or spot welded together at the option of the fabricators.

Bonding straps are lapped and nailed to the pole and crossarm with six-penny cement-coated nails. Liberal clearances are provided between the straps and all hardware except the crossarm through bolt. Wood crossarm braces are used in this construction.

The assembly is further improved by the use of hairpin-type static spring washers on the face of the crossarm. These washers insure a firm and continuous connection of the general assembly.

Aluminum-Alloy Bus Supports Cost and Weigh Less



ALUMINUM ALLOY bus supports, indicated by arrows, are used in underground vaults

G. E. LARASON, Line Devices Specialist, Oklahoma Gas & Electric Co, Oklahoma City

Aluminum-alloy bus supports used in underground vaults by Oklahoma Gas & Electric Co cost less than some other materials for the same job if all factors are considered. Other advantages of aluminum supports over other construction materials are as follows:

1. Less watts are lost at high currents.

2. Weight is approximately 1/3 less.

3. Drilling can be done in the field without damaging rust resistant qualities.

4. No paint is required.

5. Less engineering time is required because less detail is required on irregular wall surfaces. Aluminum can be cut to fit in the field.

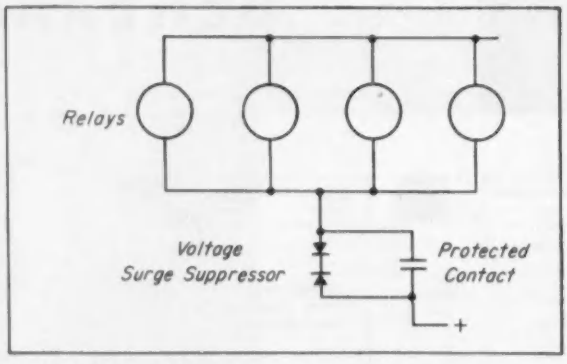
6. Less delivery time is required because some material must be galvanized after fabrication.

Surge Suppressors Extend Relay Contact Life

A. B. DAY, Engineer, Idaho Power Co, Boise

Longer life of contacts in relay circuits is promised through the use of selenium-rectifier voltage surge suppressors. In one installation on the Idaho Power system, suppressors installed on 51 contacts on an indirect bus have extended the contact life to 24 months without a sign of failure. Before suppressors were installed, contacts lasted a minimum of 3 months and a maximum of 18.

Savings in time and labor accompany longer contact life. Installation of a suppressor costing less than $2 required about 2 hr in a supervisory relay circuit. Prior to the installation, contacts were replaced a number of times at a total cost of $28 for parts and labor, not counting travel time to the equipment.



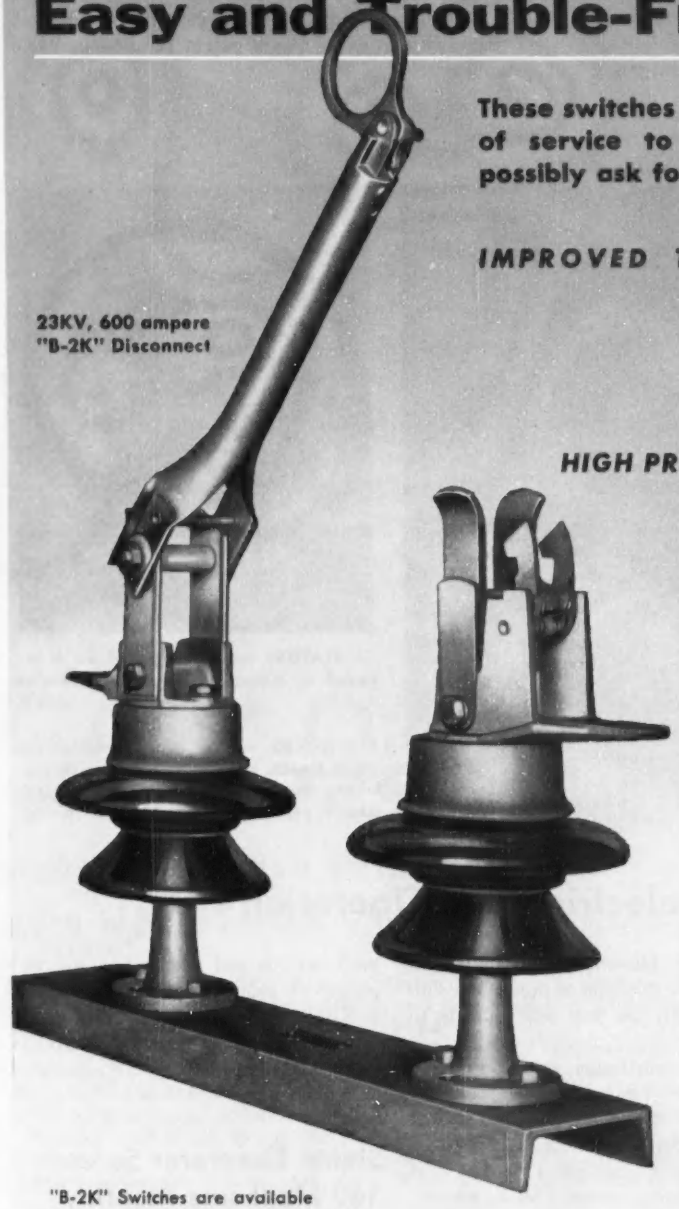
SELENIUM RECTIFIERS applied back-to-back form voltage surge suppressor across relay contact to greatly extend life of the contact

Voltage surged suppressors are particularly applicable in circuits where a great number of relays are released simultaneously across one contact and create a consider-

(*Continued on page* 100)

Use Delta-Star's B-2K Outdoor Disconnect Switch for Easy and Trouble-Free Operation

These switches have been proved through years of service to provide everything you could possibly ask for in an outdoor disconnect.



23KV, 600 ampere "B-2K" Disconnect

IMPROVED THERMAL CHARACTERISTICS

Hard drawn copper contact shoes with ample material for heat dissipation. Hard drawn tubular copper blade constructed to avoid any possibility of contact misalignment.

HIGH PRESSURE LONG-LIVED CONTACTS

Contact shoes have heavy rolled silver inlays at points of contact which press firmly against copper blade. Pressure maintained by fatigue resistant beryllium copper alloy cantilever springs. Contact at hinge end made by blade operating against silvered hard drawn copper bars.

RIGID BLADE CONSTRUCTION

The hard drawn tubular copper blade is split and flared at the hinge end which gives it great transverse stability. No possibility of contact misalignment. A cast bronze insert is riveted inside the blade at the clip end to prevent distortion when slamming it closed.

IMPROVED BLADE PRYOUT

Operation is quick and easy in all types of weather with positive, effortless operating blade pryout and lock assembly, and large 3-inch hook ring. A slight pull on the hook ring is all that is necessary to break ice or corrosion accumulations.

"B-2K" Switches are available in single and double throw for upright and inverted mountings, in current ratings of 600 and 1200 amperes and in voltages up to 161KV.

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHING EQUIPMENT SPECIFY DELTA-STAR

DELTA-STAR ELECTRIC DIVISION

H. K. PORTER COMPANY, INC.
OF PITTSBURGH
2437 FULTON STREET, CHICAGO 12, ILLINOIS
DISTRICT OFFICES IN PRINCIPAL CITIES

Ask for Publication 5104

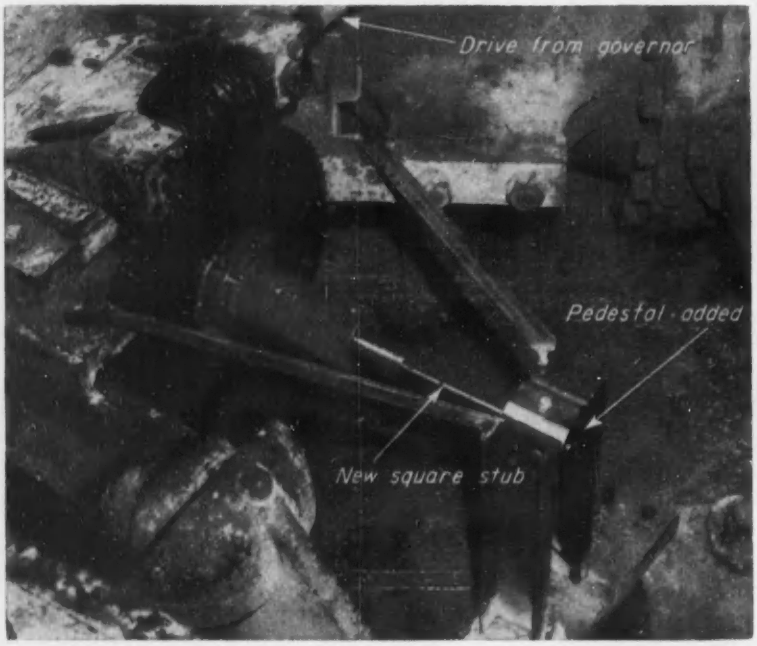
Suppressor

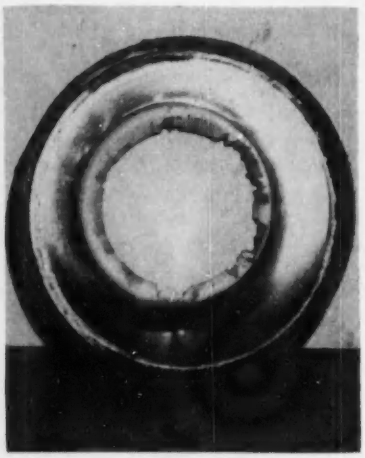
(*Continued from page* 98)

able self-induced voltage. Suppressors chosen by Idaho Power Co make use of two selenium rectifiers. (Investigation of Selenium Rectifiers for Contact Protection, Herbig and Winters, AIEE Proceedings, 1951, Vol. 70).

Rectifiers are placed back-to-back across the contact to be protected, as shown. The characteristic of selenium rectifiers whereby resistance decreases as applied voltage increases acts to prevent the induced voltage from arcing across the contact by offering a low-resistance path. As energy is absorbed in the resistance of the circuit, the induced voltage decreases and the resistance of the rectifier goes up 20 to 40 times. This acceleration of energy absorption minimizes relay release time.

Inspection routine for the 15 suppressor installations consists of visual inspection, burnishing of contacts and dusting and cleaning with a tack cloth about every six months. Suppressors used by Idaho Power were supplied by a manufacturer which has a patent pending covering this application.





CAVITATION caused by glacial silt is retarded by plating nozzle tips and needles

REDESIGNED needle stem assembly will lessen chances of jamming in mechanism controlling movement of needle in nozzle tip. Stub rides in pedestal to keep stem from turning

Two Ideas Improve Hydroelectric Plant Operation

Redesign of the needle stem assembly for hydro-turbines at the Electron Plant of Puget Sound Power & Light Co lessens considerably the chance of damage and jamming of the assembly. Another idea that has improved operation is the electrochrome plating of nozzle tips and needles to reduce cavitation caused by glacial silt.

In the initial design of the stem assembly, the last 3 ft of the 9.5-ft stem was machined with a square thread. A keyway ran the full length of the thread. A key in the threaded hub of the worm-wheel driven from the governor kept the stem from turning but permitted it to slide in and out.

In moving, the stem advances or retracts the needle with respect to the nozzle tip. However, a keyway across threads for this type of movement subjected both the key and threads to damage.

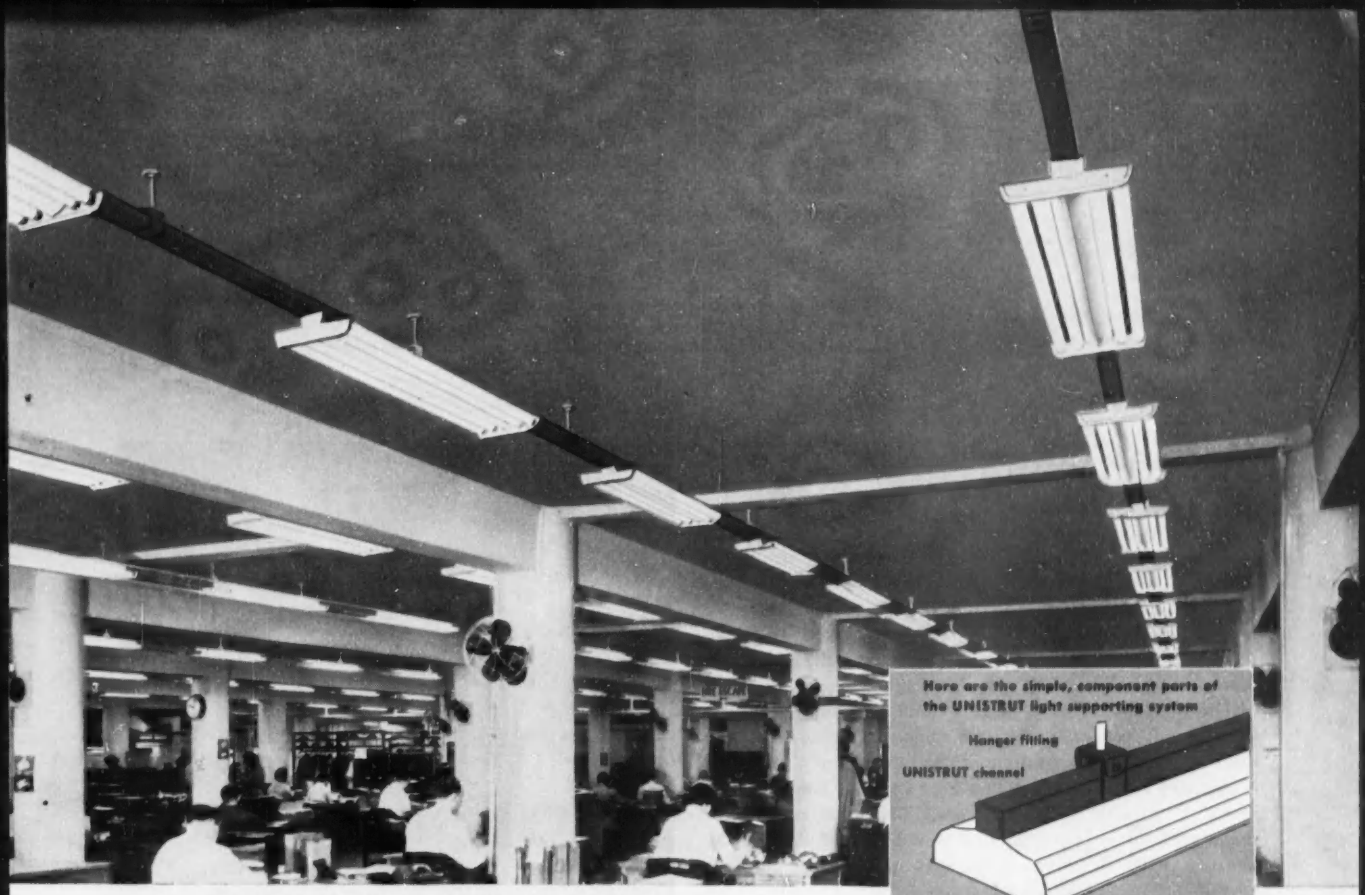
In the new design, the keyway and key were eliminated by adding a square stub and sleeve to the end of the needle stem. The stem is kept from turning by the stub that rides in and out of a square opening in a pedestal. Location of the pedestal is shown in the illustration. The new stem assembly was built in the Electron machine shop.

Electrochrome plating of the needles was done four years ago. A plating of 0.015-in. thickness was applied after needles were machined to shape. A recent inspection disclosed no sign of cavitation on any of the needles. Now both needles and nozzle tips will be plated as required. Cost of plating is $100 per set of needle and main nozzle tip and $75 per set for two or more sets.

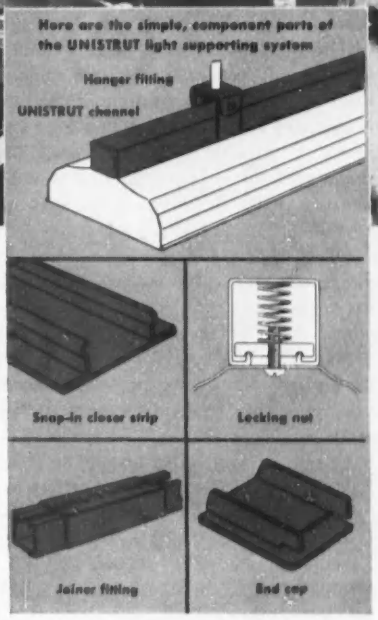
Steam Generator Saves 160 Manhours Monthly

R. C. DAFFRON, Systems Distribution Supervisor, Virginia Electric & Power Co, Richmond, Va.

Cleaning transformer cases of sludge and dirt with steam from a commercial steam generator cuts cleaning time to 12 to 15 min compared with about one hour previously required by hand cleaning. Approxi-



Installation by: Hultgren Electric Corp., Electrical Contractors, Chicago, Illinois.



50% Savings!

Lighting installed at half the cost with UNISTRUT® *channel and fittings*

New fluorescent fixtures were recently installed on two floors of the Butler Brothers Building, Chicago, Illinois. The savings on this UNISTRUT installation over conventional methods was estimated at fifty percent. How did UNISTRUT reduce installation costs?

By using UNISTRUT channel with its continuous slot to attach fixtures quickly in perfect alignment. And by using the same channel as a wireway. This fast, easy method cut costly installation time in half!

UNISTRUT channel insures true alignment. It provides the utmost in safety because the entire row of fixtures forms a single integrated unit. Fewer hanger rods are needed and a neater, more attractive installation results. Stems or rods may be placed at any point along the channel, permitting installation on irregular ceilings. Fixtures can be fastened in a continuous row or intermittently as shown here.

Get in touch with your UNISTRUT Distributor for the full, cost-cutting facts on light supporting with UNISTRUT framing.

UNISTRUT.

U. S. Patent Numbers 2327587 2329815 2345650 2363382 2380379 2405631 2541908 Other Patents Pending

SEE OUR CATALOG IN SWEET'S

The World's Most Flexible All-Purpose Metal Framing

Distributors and warehouse stocks in principal cities. In Canada, Northern Electric Company. Consult your telephone directories.

Write today for free fluorescent lighting bulletin FF-3.

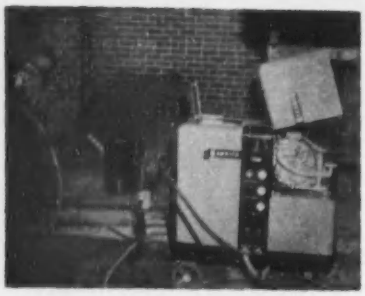
UNISTRUT PRODUCTS COMPANY DEPT. W-5
1013 W. Washington Blvd.
Chicago 7, Illinois

Name.....

Company.....

Address.....

City.....Zone....State.....



CLEANING distribution transformer case is done in 12 to 15 min with steam generator compared with 1 hour for hand cleaning

mately 160 manhours are saved monthly by use of this equipment. A much better cleaning job is obtained (inside and outside) and the surface is better prepared for a smoother and longer lasting paint job.

The steam cleaner is operated at 90 lb vapor pressure during cleaning process. Detergent is mixed with the steam by the machine. Hot water is used for final washdown. Nozzle has insulated handle.

Previously, hand cleaning using a scraper and brush with solvent, produced an inferior cleaning job and a poorly prepared surface, which resulted in a poor paint job.

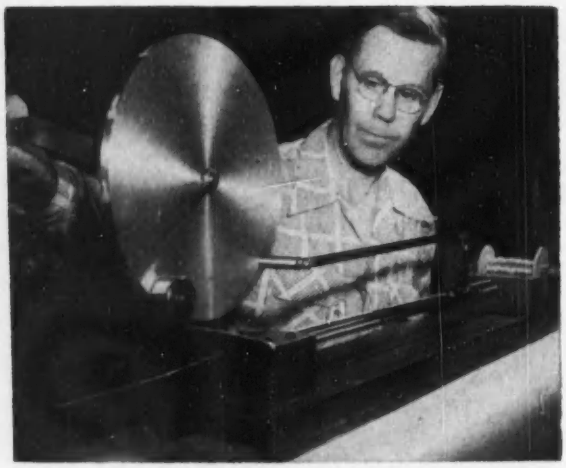
Machine Cuts Uniform Lengths of Wire Rapidly

An automatic wire-sizing and cutting machine developed and used by Temco Aircraft Corp turns out 11½-in. lengths of 0.041-gauge wire at a rate of one per sec. Although the machine was developed for small wire, its principle of operation can be applied for cutting heavier wires (tie wires).

The machine, costing $23 for labor and material, is 40 in. long and rests on a table. Its principal part is an aluminum wheel, 12½ in. in diam. When the wheel is cranked, it operates a pull rod attached near its rim. The pull rod, in turn, activates a clamp mounted on a carriage which grabs and unreels the length of wire from a 5-lb spool at one end of the machine. A flat steel spring keeps pressure on the spool preventing backlash.

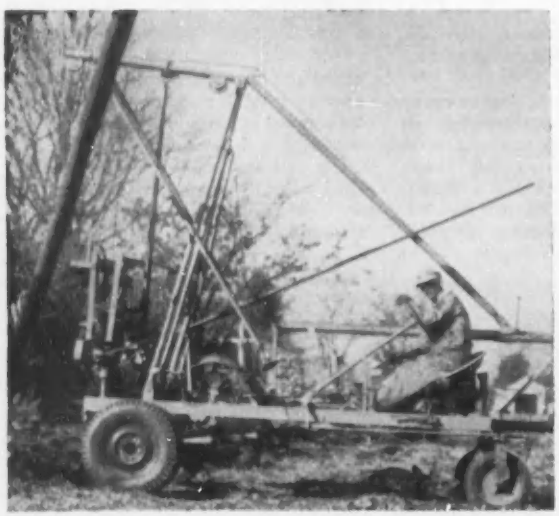
Wire is pulled the length of the machine through an aluminum tube. It emerges through an 0.062 bushing, over which is mounted a tool-steel cutter with a shear edge. A roller is mounted near the rim of the wheel. With each revolution of the wheel, the roller presses down on the cutter and cuts the wire protruding from the bushing. A spring raises the cutter after each slice or cut is made.

Length of wire to be cut can be changed by moving the point at which the pull rod connects to the wheel and can be figured as follows: length of wire equals double the distance between the pull rod attachment and the axis of the wheel.



CUTTING WIRE by machine results in exact lengths with clean cuts

To use the machine for cutting heavier wire, the pressure put on the wire by the clamp must be increased. This can be done by lengthening the pressure lever, the short rod joining the pull rod to the clamp.

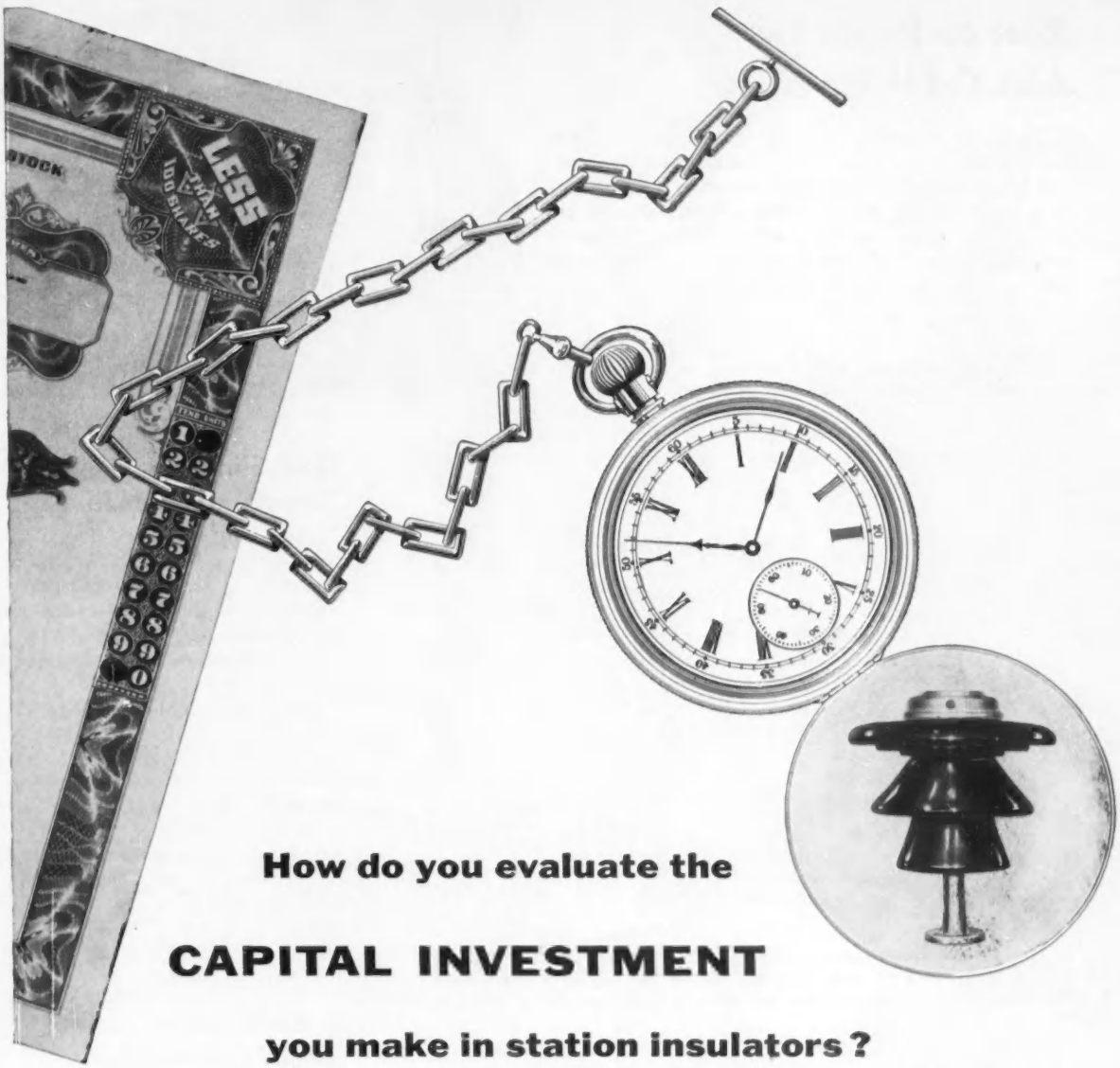


Self-Propelled Digger Proves Versatile

Iowa Southern Utilities Co has used a self-powered, self-propelled, comparatively low-cast digger to good advantage on many jobs. The light-weight unit has a 16-in. bucket auger and an 18-in. spiral auger, either of which can be driven by the 7½-hp engine suspended from the boom. It has a hydraulic lift for an A frame and dual drive wheels.

The self-propelled unit can be used with the auger hole digger if the terrain is not too rough and is of special value in town. Where terrain is rough, the self-powered hole digger can be swung from a winch line, over a boom, very successfully.

LIGHT-WEIGHT, self-powered hole digger gets to many difficult places and is of special value in cities and towns



How do you evaluate the

CAPITAL INVESTMENT

you make in station insulators?

You, as a buyer of station insulators, are investing your company's capital. If you were dealing in stocks and bonds rather than insulators, you would evaluate "market value" against "annual return."

Between one make of insulator and another, the cost of buying them does not vary materially. But, can this be said about the cost of *owning* them? If one lasts longer than another, its "return" on invested capital is greater.

In the "standards-plus . . ." category of station insulator characteristics, O-B's attention to seemingly insignificant details has put extra years into the product -- witness the scores of 30-year-old installations, and hundreds in the 20-year bracket. Those have *proved* to be good investments as they have given a high rate of return on a capital expenditure.

After all, there *are* bargains in station insulators -- not bargains in first cost but definite bargains in *what you're getting for your money!* When you look at station insulators as a capital investment, you will get the best "interest rate" with O-B.

Ohio Brass

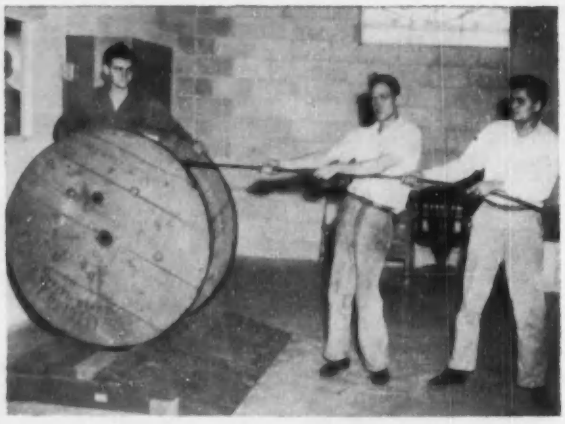
MANSFIELD OHIO, U.S.A.

4424-H

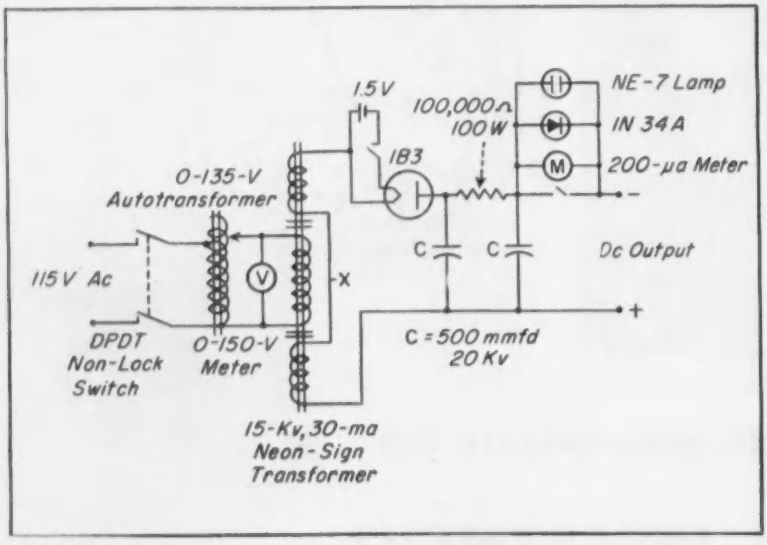
IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

Reel on Roller Base Aids Cable Handling

Reeling and unreeling wire has been simplified and time saved at Oklahoma Gas & Electric's new service headquarters by rolling the reels up onto a pair of rollers supported by a low platform. A short-ramp approach to platform makes it easy to get reel on and off the rollers. The rollers turn with the reel, so that the reel remains in position as cable or wire is either taken off or put on.



REELING AND UNREELING WIRE is easy with reel on slightly elevated rollers. Reel turns in place as wire is removed



OUTPUT UP TO 15 KV is provided by this test set that cost about $40 for basic parts. 1B3 tube and battery used as rectifier and neon-sign transformer replace costly components

Low-Cost Set Tests 5-Kv Cables

GENE J. NEWMAN, Construction Supt, Civil Aeronautics Administration, Seattle, Wash.

Insulation testing and reducing faults by the condenser discharge method on cables in the 5-kv range may be accomplished with a low-cost, high-voltage test set designed by the author. By application of standard parts and equipment, cost of the set was held to about $40, excluding the autotransformer and output voltmeter.

The device offers any test voltage up to about 15 kv. Its main features include use of a low-cost neon-sign transformer with automatic current limiter, use of a 1.5-v battery and 1B3 tube as a rectifier in place of filament transformer and rectifier tubes, and use of a germanium diode backwards and a neon bulb for automatic shunt action across the output milliammeter for currents above 100 microamp.

Other equipment includes a 0—135-v autotransformer, two 20-kv capacitors with a rating of 500 mmfd each, and necessary meters and switches. To measure the output voltage, a standard-make vacuum-tube voltmeter is used in place of a more expensive low-drain voltmeter. A TV-type high-voltage probe is used in the tests. All parts except the VTVM are contained in a wood cabinet measuring 10 in. wide, 18 in. long, and 10 in. high.

Sling Simplifies Transformer Handling

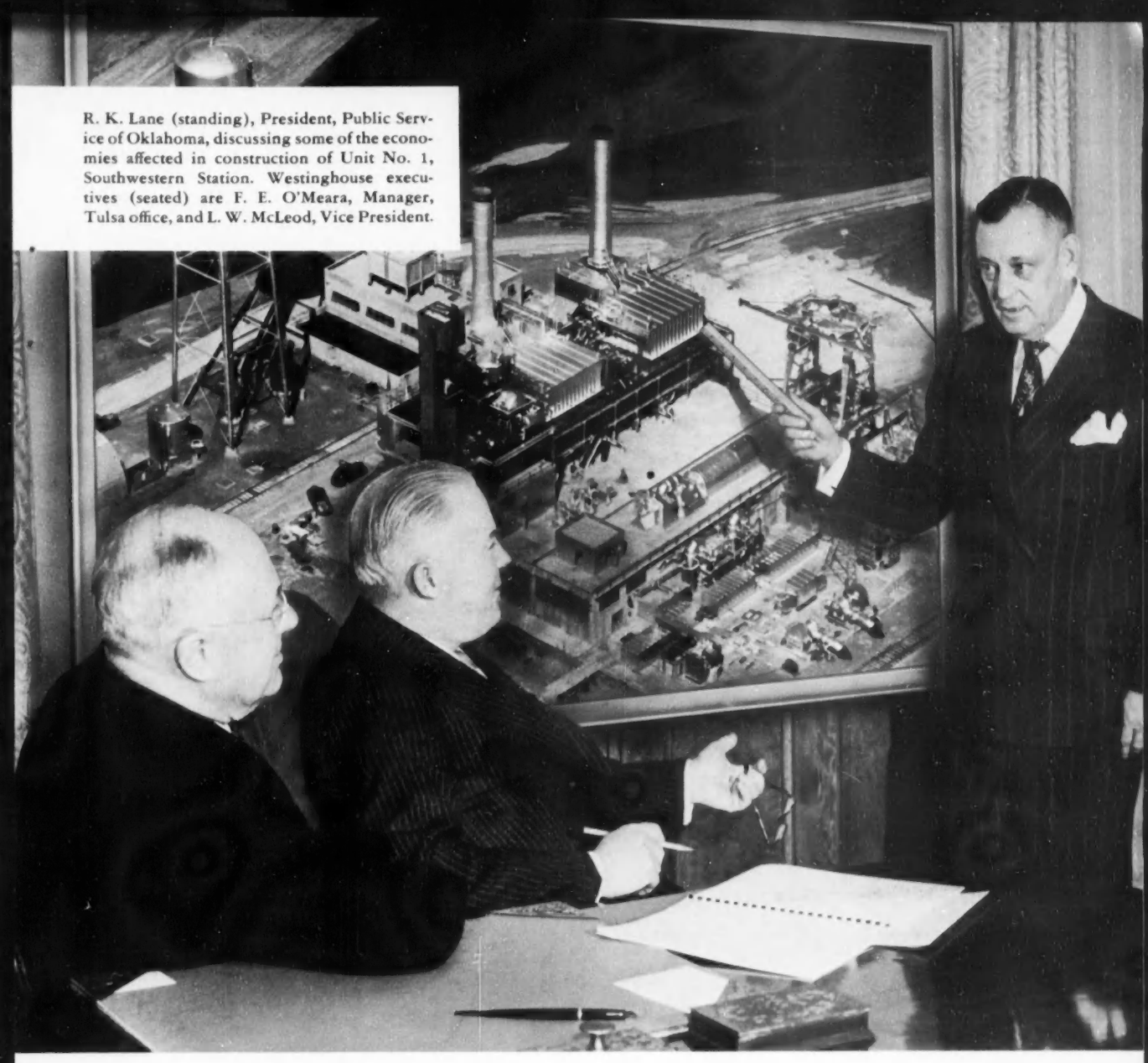
Using a sling makes transformer handling easy at Oklahoma Gas & Electric's new service headquarters. A wire-rope sling is hooked under ears of the transformer and the lift truck is run into position so the sling slides over the fork.

Suspended from the fork, the transformer is moved to or from storage, or onto line trucks that back up to the truck-bed-level storage platform. Using the sling, crated transformers are easily double-decked to save much-needed storage space. The sling, used in preference to fixed attachments, leaves the fork lift ready for general uses.

Motor-Equipped Reel Speeds Coil Winding

Fitting a hand-operated take-off reel with a ¼-hp electric motor and a gear mechanism from an old washing machine permits workmen of Puget Sound Power & Light Co to make up 200-lb coils of new wire at a rate of 160 ft per min. The machine also aids coiling up odd lengths of wire, which must be spliced together. Speed of making coils has been increased considerably over the old-fashioned method of revolving reel by hand.

Speed-reducing gear box is driven by a V-belt and pulley on the motor side and is fitted with a roller chain and sprockets on the reel side. Approximate reel speed is 30 rpm. Spool is supported on a stand with a pipe through the middle so it can turn freely.



R. K. Lane (standing), President, Public Service of Oklahoma, discussing some of the economies affected in construction of Unit No. 1, Southwestern Station. Westinghouse executives (seated) are F. E. O'Meara, Manager, Tulsa office, and L. W. McLeod, Vice President.

From cotton field to power plant... in 369 days

Public Service of Oklahoma's amazing feat of transforming a cotton field located over a solid base of sandstone—with no access roads available—no power in the vicinity—to Unit No. 1 of Southwestern Station is a story worth telling.

Public Service started the story when they decided to meet their growing load with additional capacity in their southwestern region. The site on the Washita River, 150 miles southwest of Tulsa, Oklahoma, was selected because it had a water supply not generally available in this region. It was at the load center and the geographic center of this growing region and near the center of the Anadarko Basin oil and gas fields with a ready supply of reasonably priced fuel.

Early in the planning stages, the utility with their

(*continued next page*)

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(continued from preceding page)

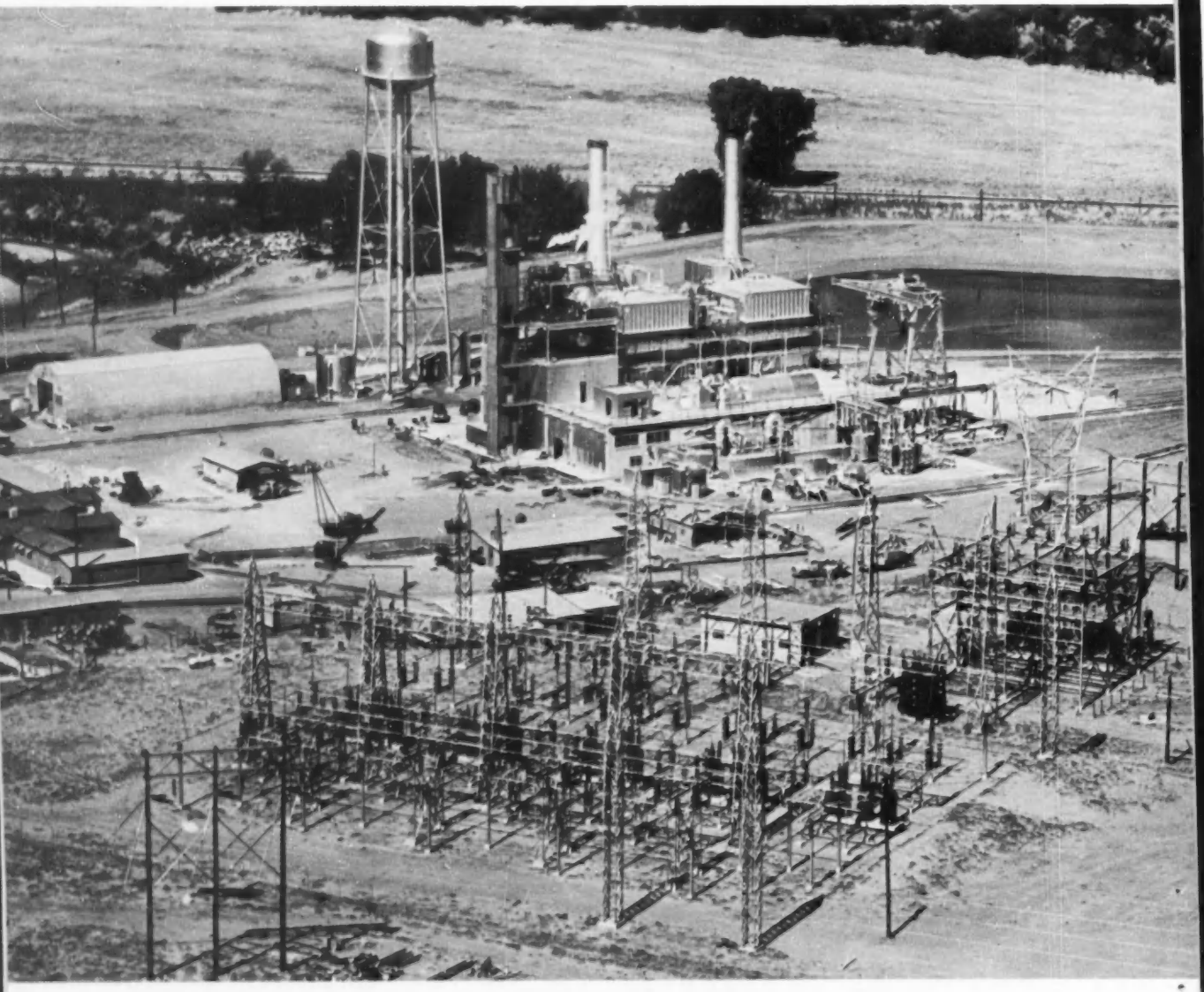
consultants (Sargent and Lundy) determined that Southwestern Station would be an outdoor station and that the prime supplier of equipment would be Westinghouse. Choosing Westinghouse as the single supplier for all major components permitted side-by-side planning and the extra advantage of on-the-spot refinements and economies in equipment and selection.

Public Service then constructed ¾ of a mile of new railroad track, rebuilt bridges and cut 3½ miles of road to the plant site.

539 construction workers were employed in erecting Unit No. 1. Weekly meetings were held throughout the construction period with foremen and construction workers to discuss progress and plan work schedules for the coming week. All personnel were thus kept fully acquainted with the over-all status of work . . . a foresight which expedited "on-the-line" date by 60 days.

• • •

Aerial view of the complete installation of Unit No. 1 at Southwestern Station of Public Service of Oklahoma showing the adjoining substation.



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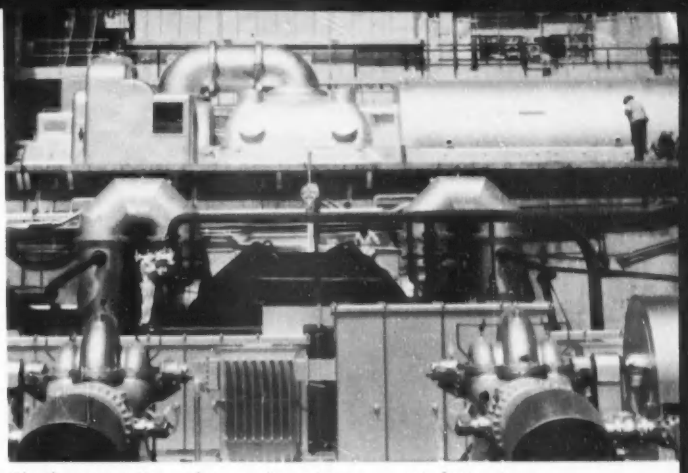
In spite of location "extras", installed cost was only $99.83 per kw output

The low installed cost of $99.83 per kw actually realized on this project as against costs of $125.00 and $135.00 per kw for a conventional power station was more remarkable in view of the many "extras" required because of location.

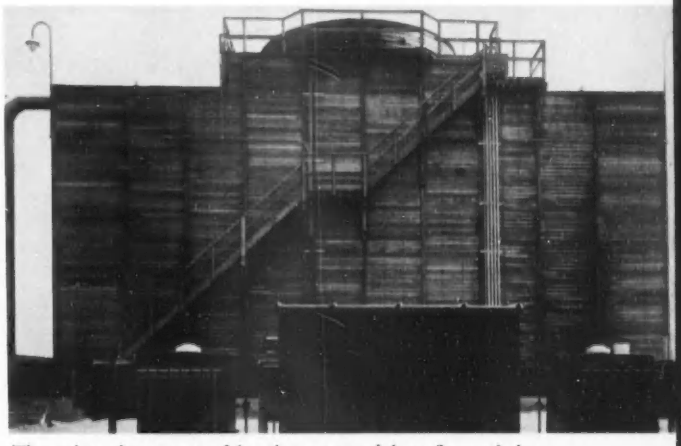
For example, a special water-treating plant was necessary due to the high mineral content of the water. The low rate of flow of the Washita River necessitated the erection of a special, eight-cell cooling tower and two water storage reservoirs holding 33 million gallons.

The cooling towers, particularly, placed unusual burdens on other station equipment. The fan on each cell required a reliable and high-torque electric motor drive, which was taken care of by using standard Westinghouse Life-Line® motors. The towers also imposed a higher pressure head on the condenser. Westinghouse met this unique problem by applying their extensive heat exchange experience to design a condenser which kept moments (forces) on the turbine exhaust within normal values, for more efficient and dependable operation.

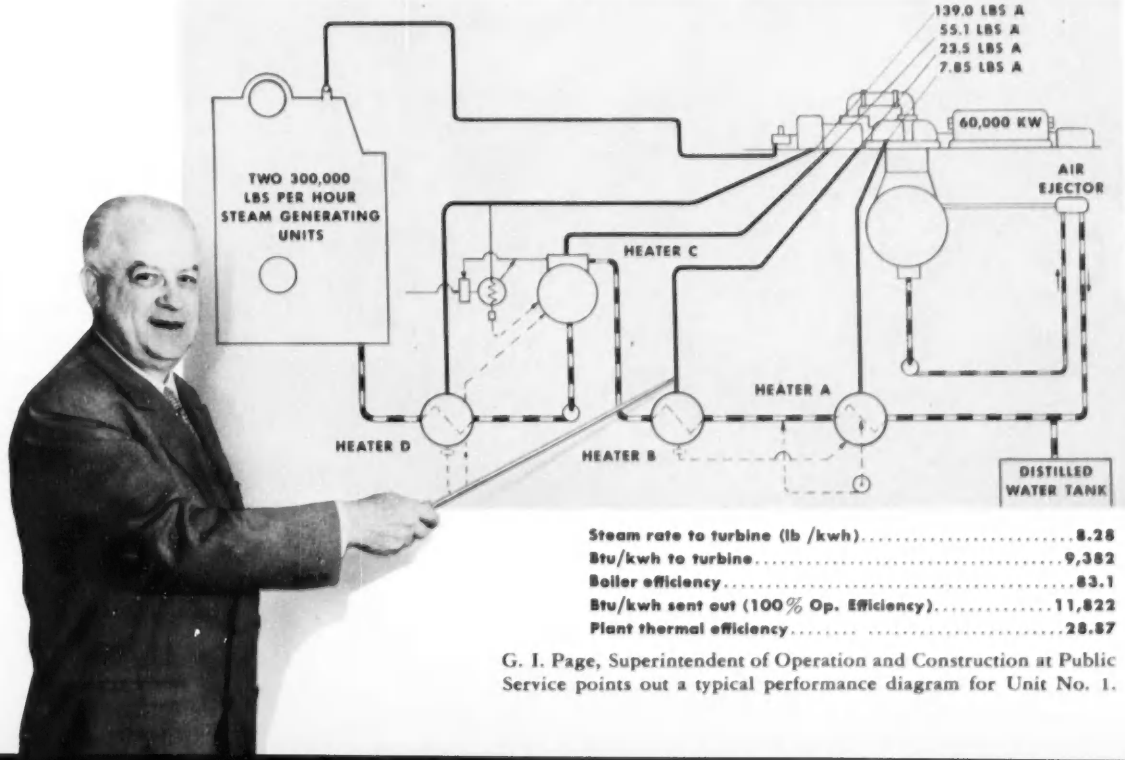
In spite of these location, design and construction problems, Public Service of Oklahoma made a remarkable record in getting "on the line" and attaining heretofore unavailable economies in new station construction.



Single source for turbine and condenser enabled Westinghouse to design for low headroom and improve performance by engineering the two as a "package" for all steam and water conditions.

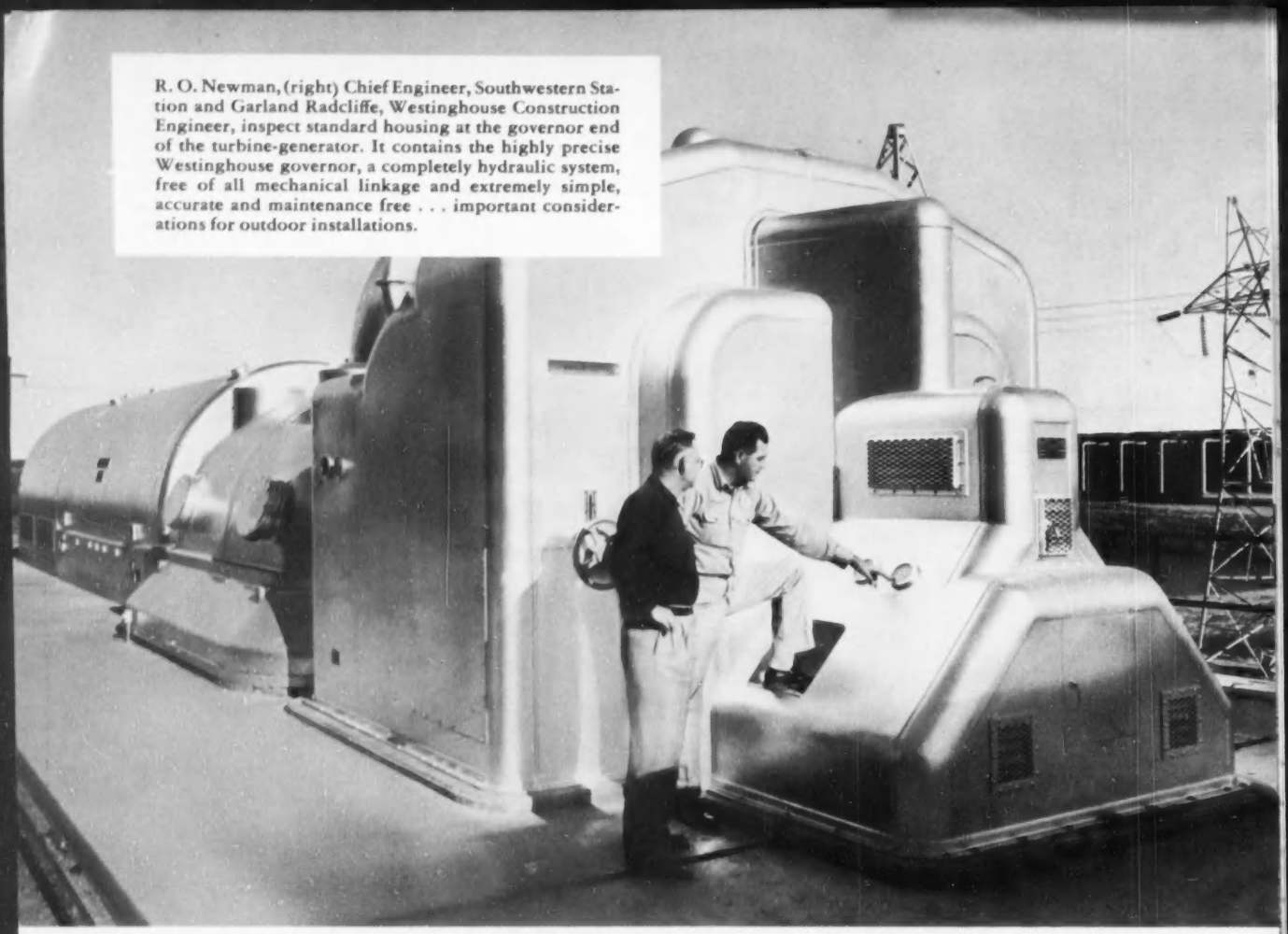


The mineral content of local water and low flow of the Washita River required a special water system. This included two 33 million gallon storage reservoirs and an eight-cell cooling tower, shown above.



Steam rate to turbine (lb /kwh)	8.28
Btu/kwh to turbine	9,382
Boiler efficiency	83.1
Btu/kwh sent out (100% Op. Efficiency)	11,822
Plant thermal efficiency	28.87

G. I. Page, Superintendent of Operation and Construction at Public Service points out a typical performance diagram for Unit No. 1.



R. O. Newman, (right) Chief Engineer, Southwestern Station and Garland Radcliffe, Westinghouse Construction Engineer, inspect standard housing at the governor end of the turbine-generator. It contains the highly precise Westinghouse governor, a completely hydraulic system, free of all mechanical linkage and extremely simple, accurate and maintenance free . . . important considerations for outdoor installations.

Design coordination of steam apparatus speeds planning, construction

One way Public Service attained low installed cost was by relying on their single supplier for recommendations and manufacturing coordination of all apparatus. This was specifically reflected in selection of the turbine-generator. Westinghouse experience in utility industry requirements indicated that Public Service's desire for maximum economy could best be met by specifying a 66,000-kw ASME-AIEE Preferred Standard Design. This choice not only cost the utility less for actual equipment, but reflected additional savings in speedier delivery.

Coordination proved valuable in other areas as well. In outdoor plants it is essential to keep headroom low and locate major components in a compact area—to realize savings in foundation and structural costs. In helping Public Service effect these cost reductions, Westinghouse designed their turbine-generator and condenser for low headroom installation, using conventional bottom-mounting, instead of a more costly side-mounting condenser.

The same problem of space economy led to the use of vertical-type feedwater heaters. The ruggedness and high efficiency demanded for outdoor installation and effective boiler feedwater heating are inherent in the design of the one high pressure and two low pressure units which were furnished. No extra construction, protection or design consideration was needed.

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Unique techniques expedite installation, lower costs

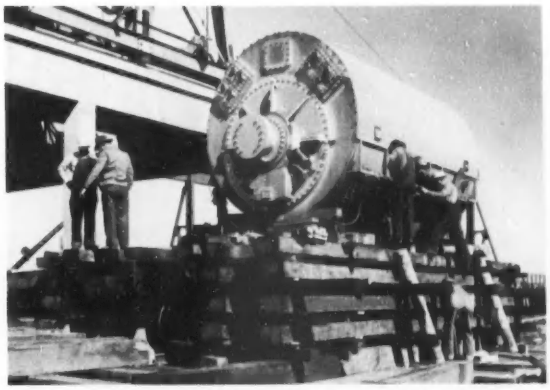
W. C. McGuire, Project Manager for Public Service, assisted by Westinghouse field engineers, used every possibility afforded by the outdoor construction and Westinghouse design simplicity and coordination to set the Southwestern Station "on-the-line" record.

Again the planning and supply of all apparatus from a single source was a major factor. The care and skill of Westinghouse turbine design and manufacture, especially, made installation of the turbine an easy job. The precise factory balancing of the rotor, the extensive factory testing before shipment, the coordinated design of turbine and generator streamlined the installation and resulted in perfectly smooth operation from the moment the turbine went on the line.

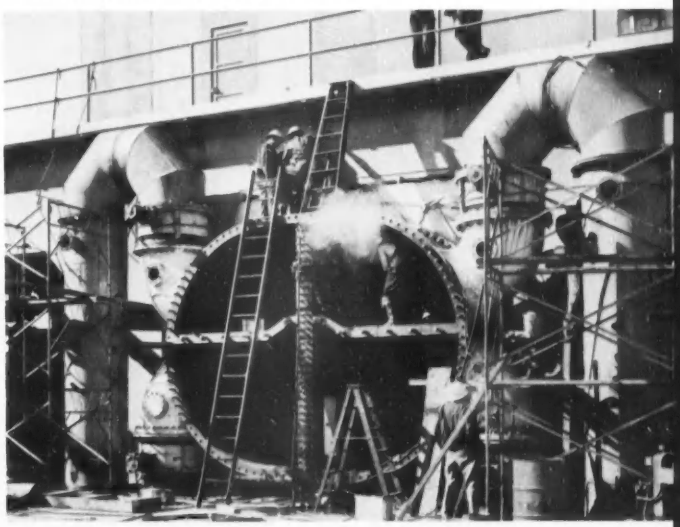
The completely self-contained generator with hydrogen cooler was moved into position alongside the foundation and thus easily slid into place. This saved many man-hours of work.

Westinghouse also designed the condenser for welded assembly right on the job—split along the horizontal. It was again, a simple matter to assemble outside the foundation and slide into place . . . ready for final connections. Similar procedures worked equally well with all the other heat exchange apparatus which was assembled on the ground and readily hoisted into place, resulting in a saving over more conventional methods.

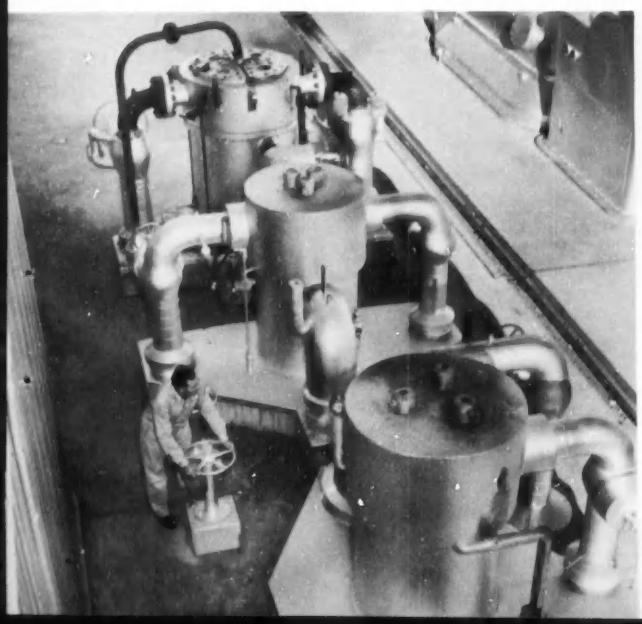
Expert design and precise manufacture of this turbine rotor help assure perfect mating of turbine and generator. It is a big reason why Westinghouse turbine-generators get on the line quickly and stay on.



Public Service of Oklahoma saved time and money by cribbing up the Westinghouse generator level with the top floor, then sliding it into position on the foundation. Outdoor construction of the station and rugged integral design of the generator made this possible.

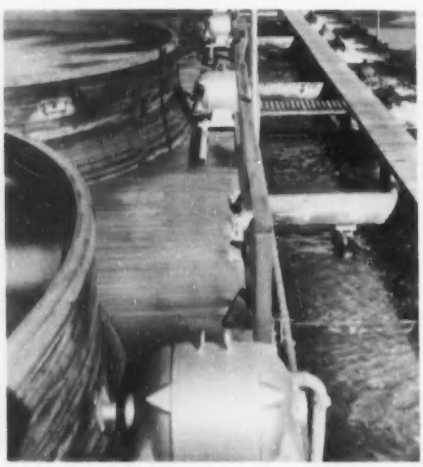


Shell of specially designed condenser in place. Top and bottom sections were completely assembled and welded outside the foundation—a cost-saving technique made available through Westinghouse experience.



◀ Chief Engineer R. O. Newman at feedwater heaters. The high pressure unit, to the rear, is equipped with exclusive quadrant head—specially designed to provide the strongest construction and greatest dependability.

Project Manager W. C. McGuire checks blueprints of the circulating water pumps which operate at 30,000 gpm. They are driven by Westinghouse 800-hp, 14-pole induction motors. Special weather-protected construction provides adequate outdoor protection here with minimum expense. Covers and air shields of these motors are easily removed for inspection. The split-bearing construction permits removal without disturbing the bracket mounting.



Each of the eight giant fans on this cooling tower is powered by a Westinghouse Life-Line motor. The tower's total capacity of 60,000 gpm is part of the service water and treated water systems, supplementing intake from the Washita River.

Condensate is pumped by this 60-hp, Life-Line CSP® motor to the deaerating tank and heater. A duplicate stand-by motor is provided. Vertical mounting of the motor integral with the pump shaft saved space and time here.

Compact control centers provide one-point control and protection of powerhouse auxiliaries. Standard vertical sections provide complete flexibility. Motor starters up to NEMA size 7 can be included.

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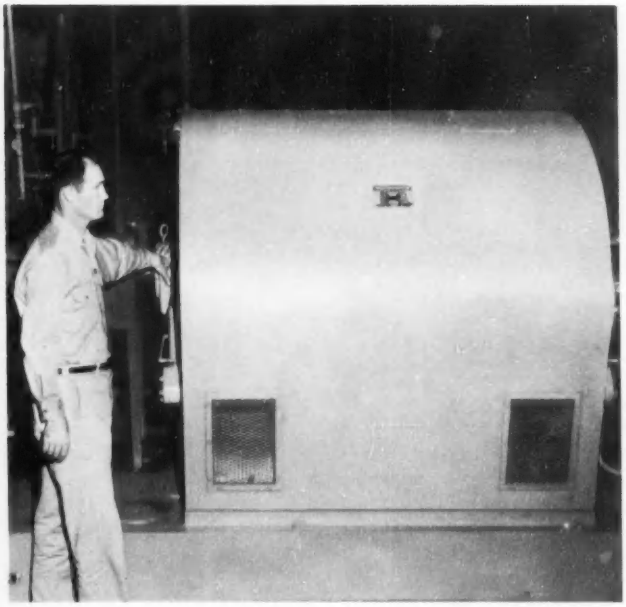
Special attention given powerhouse motors insures economy of electrified auxiliaries

By relying on Westinghouse powerhouse motors for all auxiliaries at the Southwestern Station, Public Service of Oklahoma gained many installation and operating economies. Westinghouse engineers special-ordered each motor for maximum attention to construction details and minimum delivery time. Once installed, each motor was quickly tied into the station auxiliary power system. The expense and time of constructing auxiliary steam lines and reducing stations were eliminated.

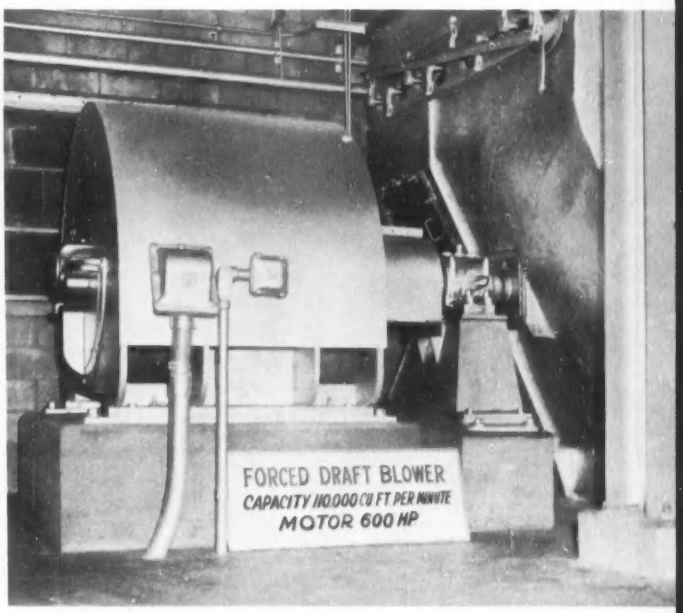
Operating economy resulted, too. Without auxiliary steam requirements, make-up feedwater demands were reduced . . . an important factor at Southwestern Station where extensive feedwater treatment is necessary. In addition, auxiliary motor control panels are centrally located to cut down on time required for operation.

Westinghouse engineers assured Public Service of Oklahoma of the continued economical operation of these powerhouse motors. Each installation received special attention: first, in analyzing load conditions and horsepower requirements; next, in construction, with all component parts being tested for highest quality workmanship. Finally, before shipment, each motor was given a complete operating test and inspection by the Westinghouse quality control department.

Westinghouse powerhouse motor insulation provides greatly improved dielectric and physical strength as well as superior moisture resistance. Two extra dip and bake insulation treatments are given all powerhouse motor windings as added protection against heat, dust and other adverse operating conditions.

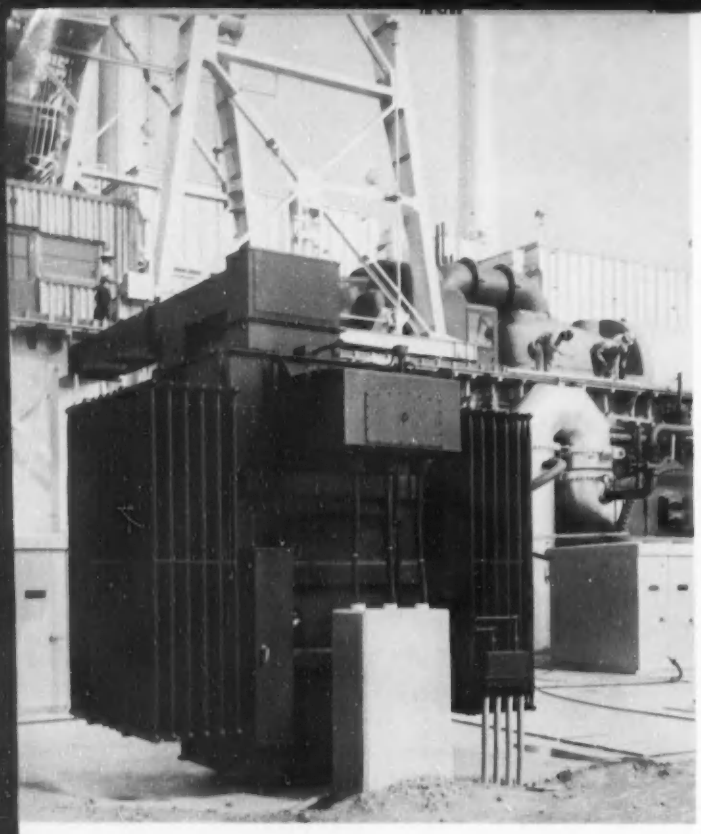


Two 1750-hp, 3600-rpm Type CSF motors supply power for boiler feed pumps in Unit No. 1. These motors are self-ventilated with louvers and internal baffling to direct air flow to best advantage.



Forced-draft blowers on both boilers in Unit No. 1 are powered by Westinghouse 8-pole, 600-hp weather-protected induction motors.

Westinghouse



Shown above, one of two identical Westinghouse 6000-kva, 13,800-volt auxiliary power transformers of core form design. Westinghouse core form transformers can be built using one of five types of windings to meet specific current and voltage requirements. These five types are: (1) Continuous pancake, (2) Hisercap, (3) Lowgrocap*, (4) Helitran, (5) Cylindrical. *Trademark

Transformer design adaptable to fast, economical installation . . .

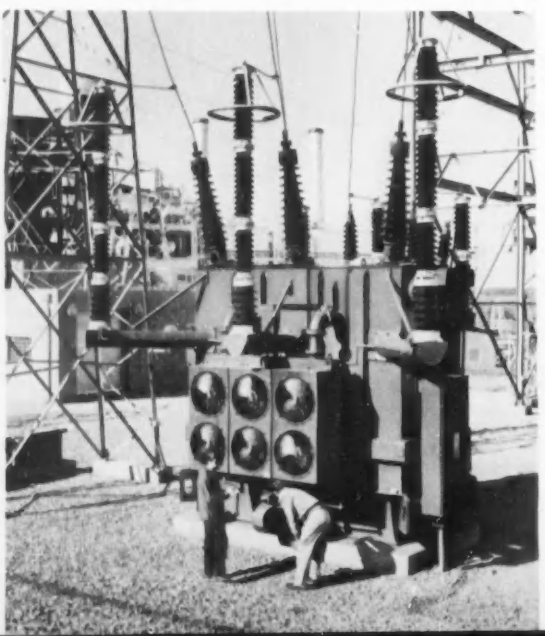
For instance, a 97-ton, 50,000-kva Westinghouse autotransformer was installed in 9 hours flat, resulting in an inexpensive installation.

The main power transformer at Southwestern rated at 88,500 kva, 138 kv, is of exclusive Westinghouse "Form-Fit" design, which enabled one-piece shipment direct to the site. Form-Fit construction using grain-oriented Hipersil* core steel with greater flux-carrying capacity permitted an approximate 20% reduction in weight, 15% smaller ground area. These factors coupled with lower over-all height made possible the use of lighter handling equipment and minimum steelwork.

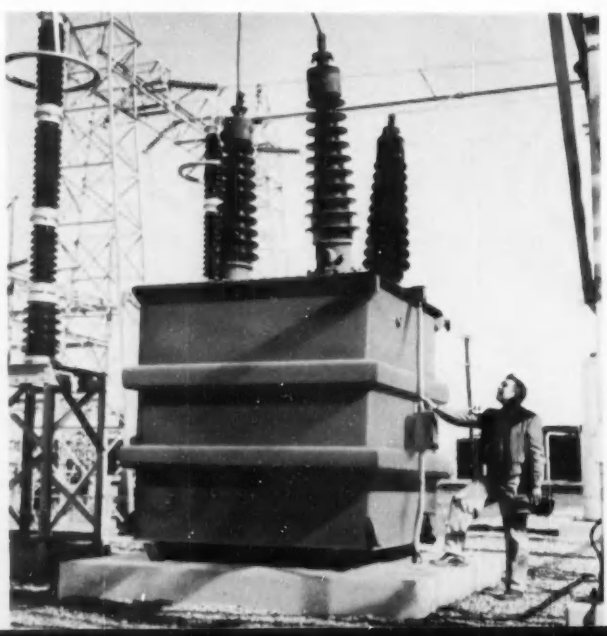
In addition, Southwestern uses economical Westinghouse standardized design transformers, of core form construction, wherever possible.

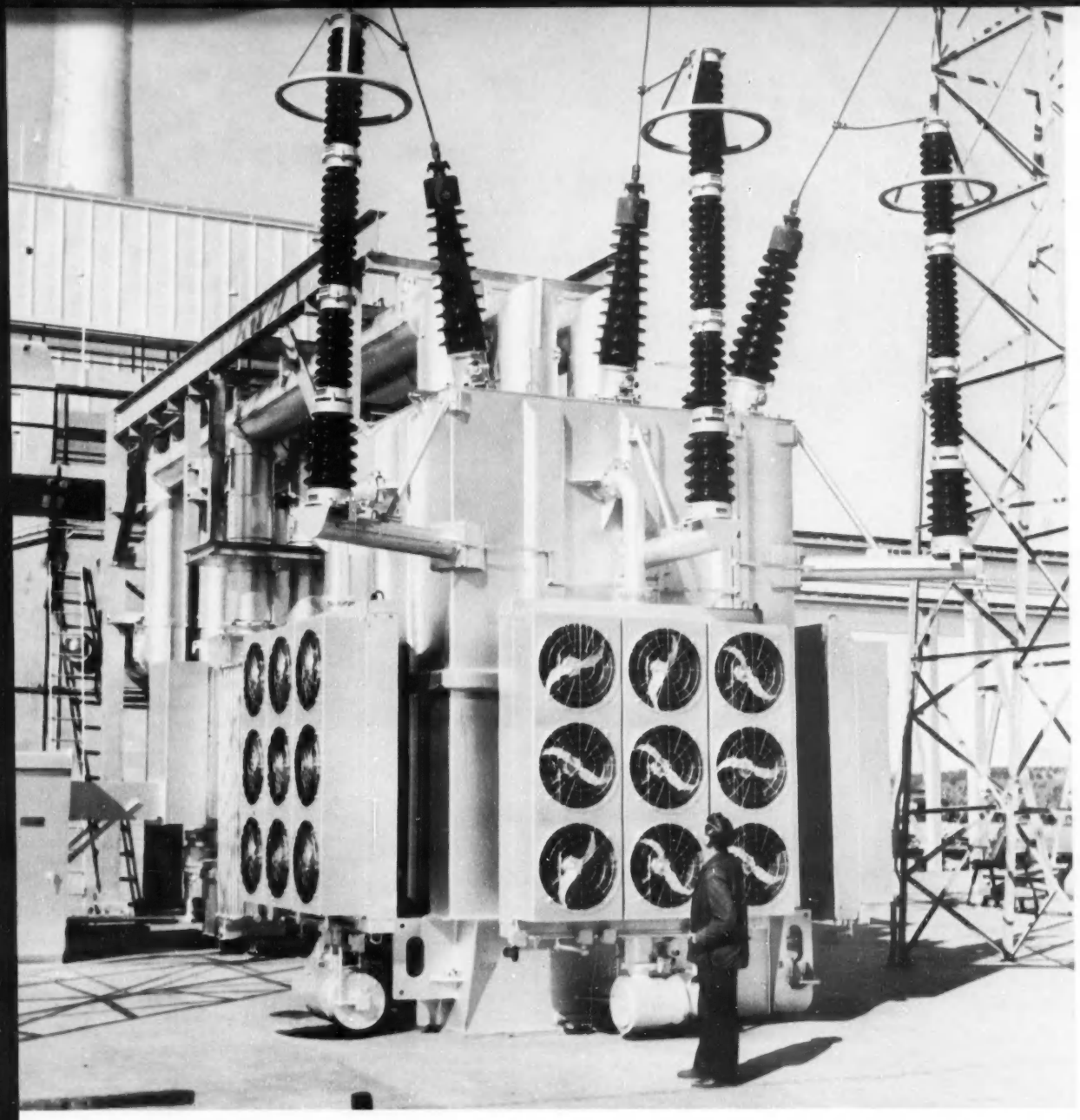
The utilization of both Westinghouse Form-Fit and core form power transformers gave Southwestern many advantages in efficiency and economy not obtainable with the application of just one design throughout. This selective factor contributed greatly to their excellent cost record.

D. R. Campbell, Station Engineer and R. W. Ingalls, checking out the 50,000-kva, 138-kv/69-kv power transformer used in the substation. It is smaller and lighter per kva because of its Form-Fit construction. The lightning arresters are Type SV outdoor arresters capable of discharging lightning surges of more than 100,000 amperes.

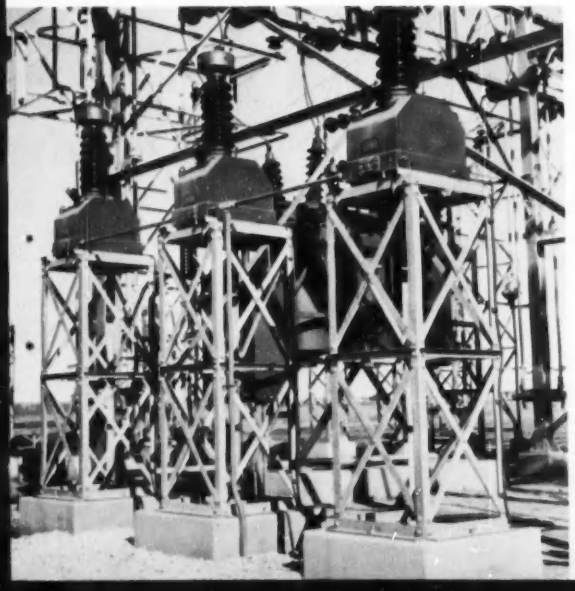


W. G. Steidley of Public Service examines the Westinghouse OA Grounding Transformer. The unit is rated 3,180 kva, three phase, 13,800 volts, 400 amperes ground current, 40 ohms per phase impedance. The hermetically-sealed Type S condenser bushings provide the highest possible dielectric and mechanical strength.





R. W. Ingalls, Assistant Chief Engineer of Southwestern Station inspects the 88,500-kva, 138-kv Westinghouse power transformer. The exclusive Form-Fit design of this FOA unit made possible smaller size and weight while still providing greater mechanical, thermal and dielectric capabilities.



◀ This neat, metering installation features three Westinghouse Type OPT Potential Transformers. Rigid production-line quality control assures dependable long-term accuracy.

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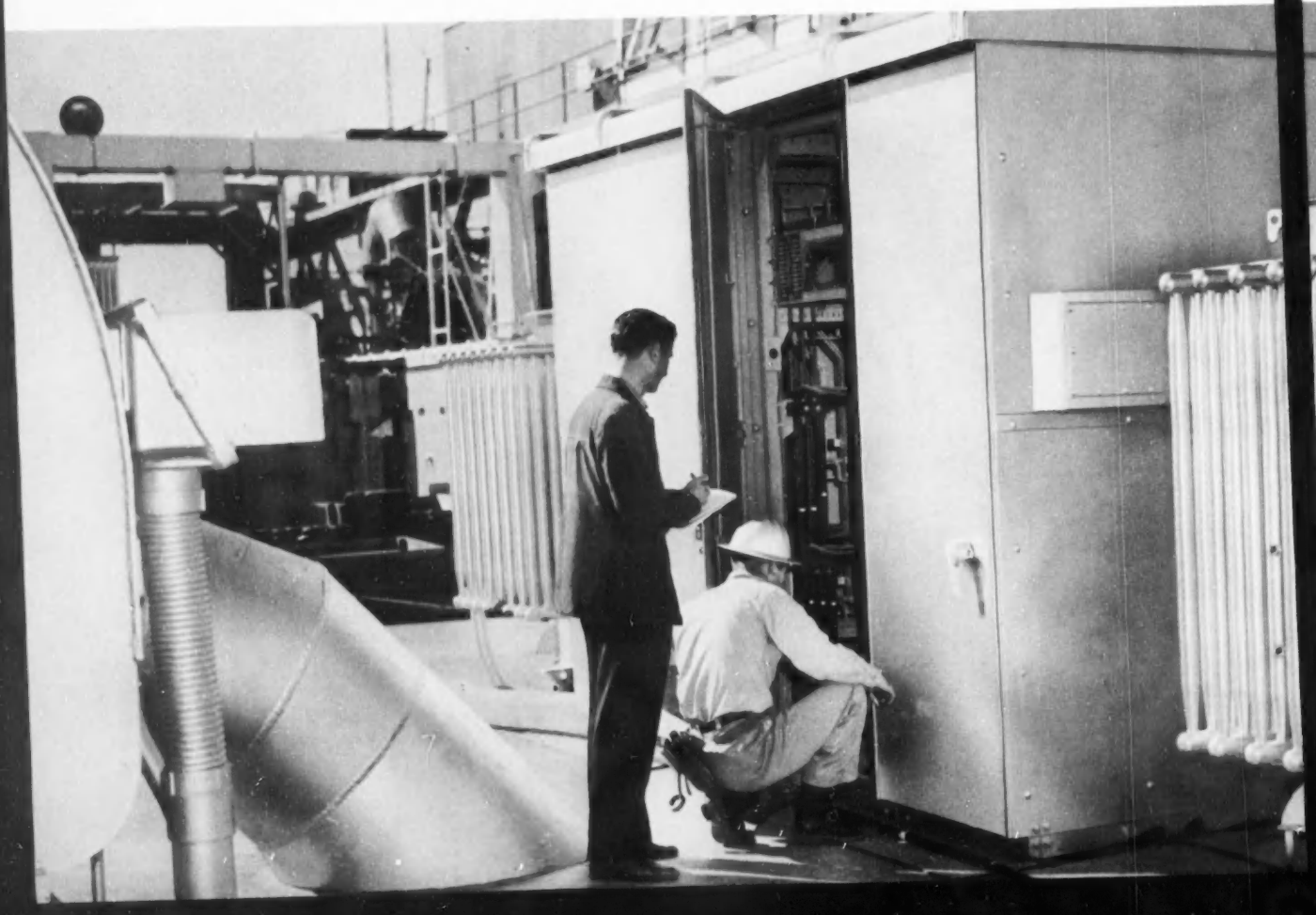


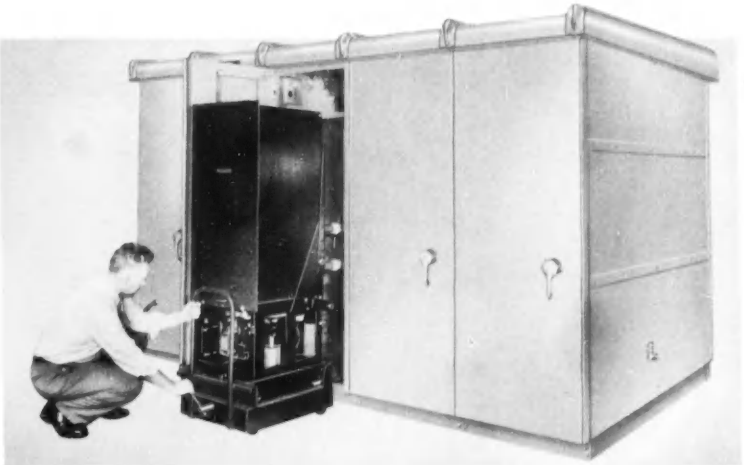
"Westinghouse outdoor metal-clad switchgear is easy to install"

W. C. McGuire, Public Service of Oklahoma's Project Manager, made this statement. He based it on outstanding features of this outdoor switchgear installation. Its compact, metal-enclosed design simplified unloading and foundation arrangements. The switchgear needed only to be mounted on the foundation, and then the main and control circuits were easily connected. The complete apparatus was factory assembled, factory wired and factory tested, eliminating all such requirements at installation point.

Standardized design throughout the switchgear contributes to lower cost of operation and maintenance. Metal-enclosed compartments provide safe, convenient accessibility to all component parts and permit more circuits in less space. Horizontal drawout breaker arrangement permits easy inspections or replacements. Maintenance of the switchgear is simpler because the time required in getting to and servicing the components is reduced to a minimum.

The integral unit design facilitates the addition of future circuits as they are required.

◀ R. W. Ingalls of Public Service is shown checking out this flexible, compact 2,300-volt Westinghouse unit substation. An outdoor installation of this type is under constant attack—inside and out. To combat internal arc damage, Westinghouse lines arc chutes with a true ceramic material containing zircon, which has the highest melting point of any known material.



De-ion® air circuit breakers used in Westinghouse switchgear draw out horizontally. No lifting or lowering is necessary. This reduces routine testing and maintenance time. Breakers of the same rating are interchangeable and can be replaced in a matter of minutes. All Westinghouse breakers take advantage of the De-ion principle of arc quenching which literally snuffs out the arc in as little as one cycle or less.

◀ The 440-volt power center, like its big brother, contains all of the basic construction details perfected by Westinghouse through years of practical application—under all conditions. To combat external weather, all metal parts are Bonderized for protection against rust and corrosion. Undersurfaces are sprayed with heavy rubberized coating.

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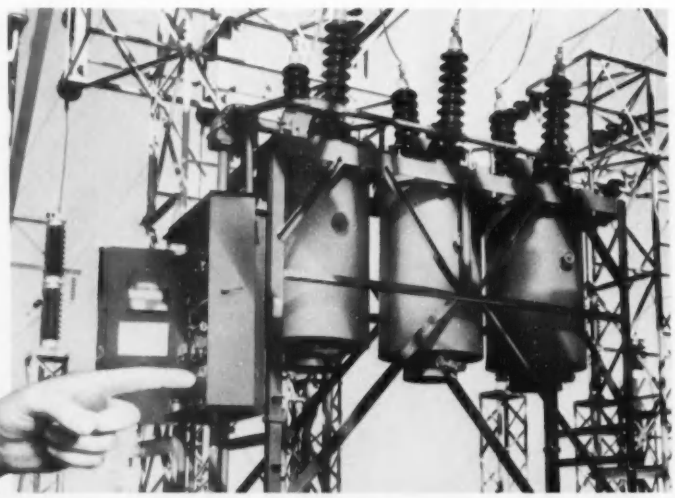
Power breaker design simplifies maintenance— field adjustments

The selection of floor-mounted Westinghouse power circuit breakers for Public Service of Oklahoma's Southwestern Station was based on their over-all simplicity of design, ease of installation, ease of inspection and adjustment. Result: less maintenance.

Westinghouse De-ion grids, for example, use the multiflow principle of arc interruption which provides high-speed clearing of faults with very short arcing time and low arc energy. Result: less contact burning and oil deterioration.

The condenser bushings used in Westinghouse power circuit breakers are designed on the sound electrical principle of uniform voltage distribution. Bushings through 69 kv are solder sealed and the higher voltage bushings are oil impregnated. Result: no radio interference, long insulation life.



Southwestern Station's Chief Engineer, R. O. Newman points out one of his Westinghouse 69-kv frame-mounted oil circuit breakers. These units were shipped completely assembled and adjusted, thus minimizing installation expense.

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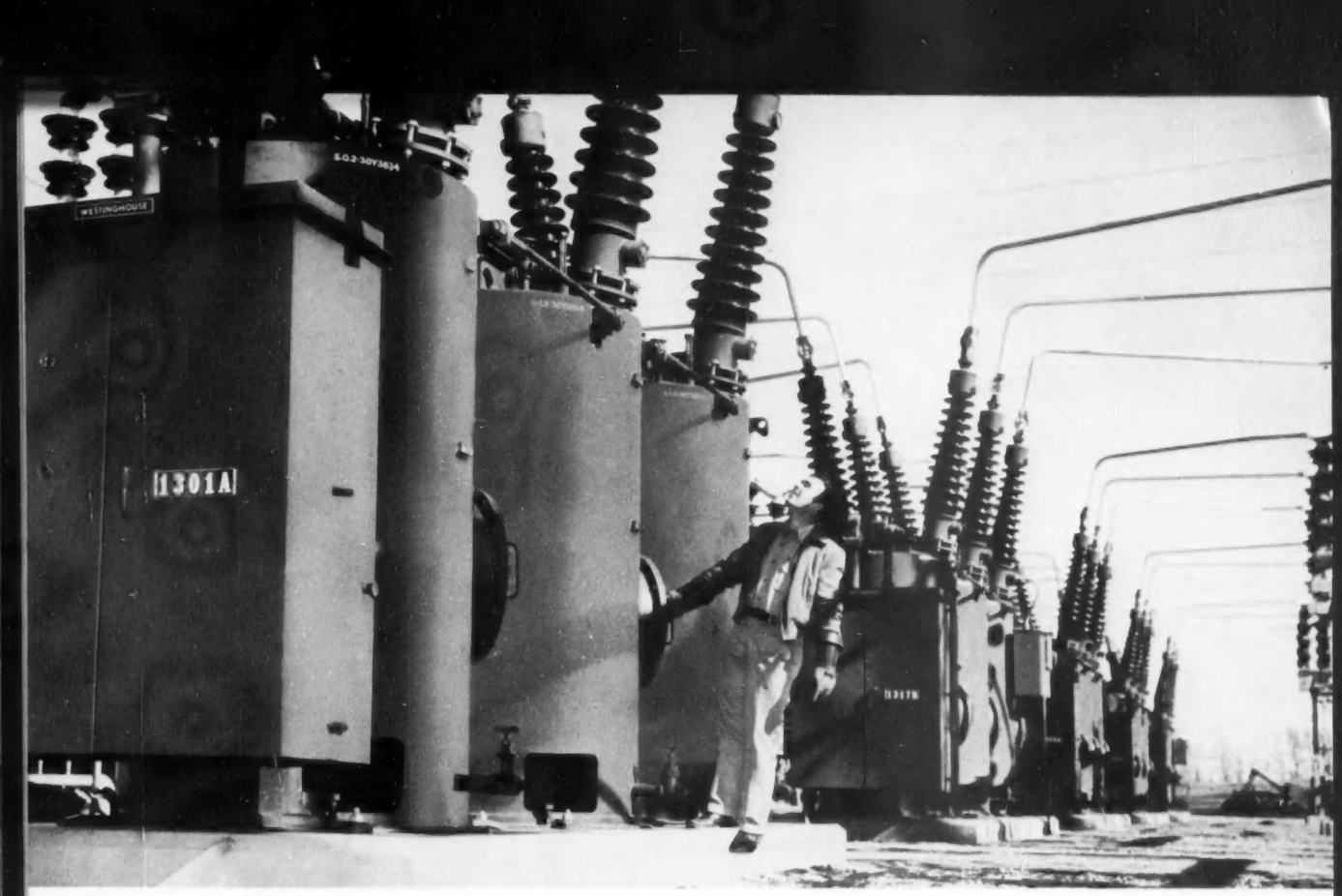
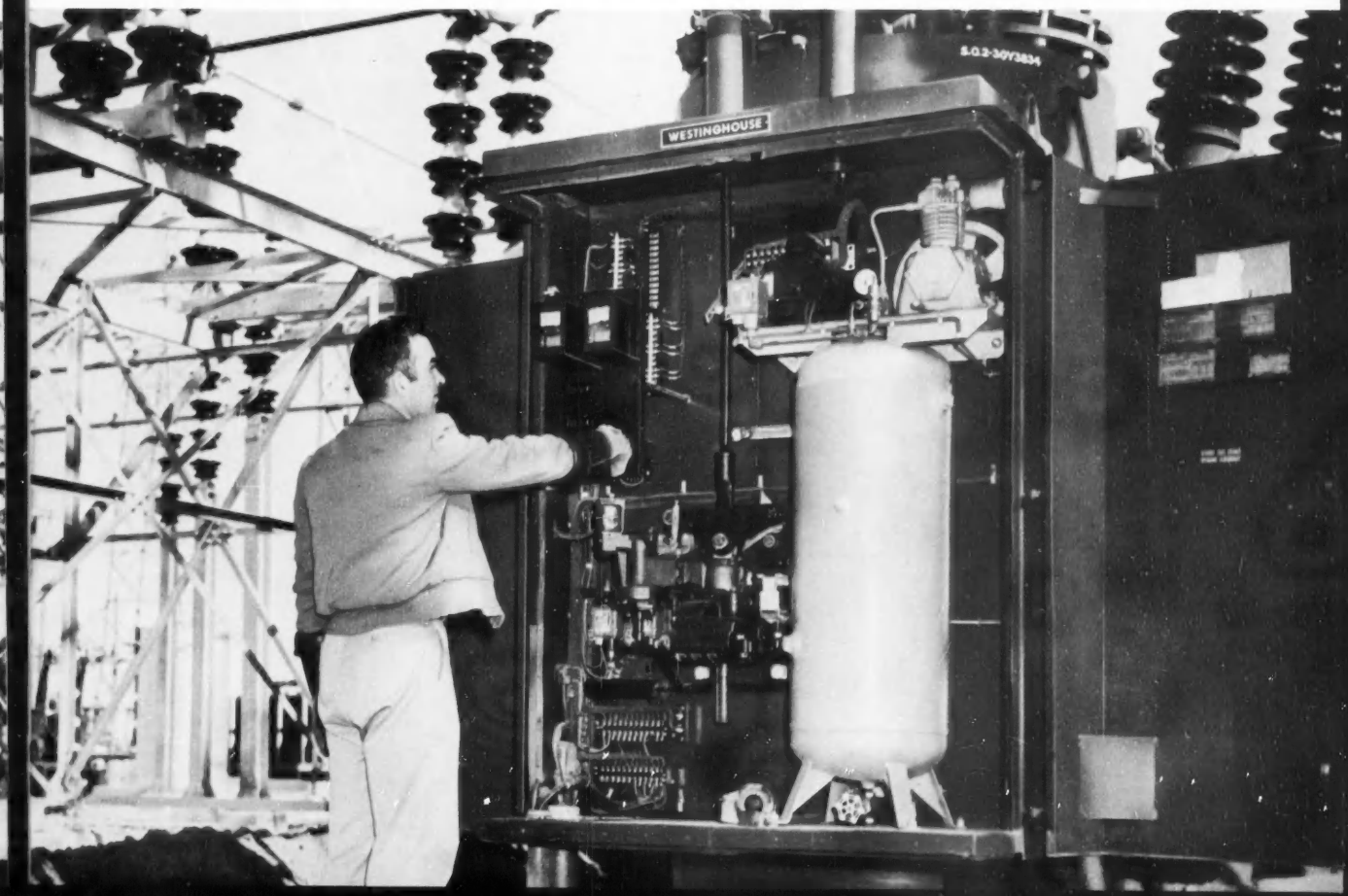
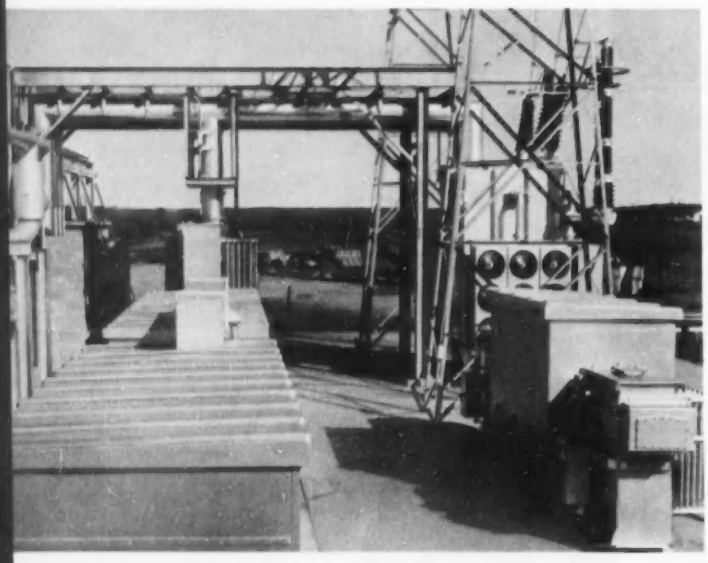


Above, W. G. Steidley checks an imposing line-up of Westinghouse Type GM, 138-kv breakers. Known for their High-Power-Laboratory-verified fast fault clearing and high-speed reclosing, Westinghouse breakers aided Public Service of Oklahoma in increasing load limit and improving system stability—with a minimum investment in transmission lines and equipment.

Below, the pneumatic operating mechanism shown operates all three poles of the three-phase breaker simultaneously. Westinghouse mechanisms are mechanically trip free to insure fast parting of contacts under any condition of opening. Reclosing can be as fast as the system requires —without shock or hammering of mechanism parts.





In the upper background is a portion of the Westinghouse isolated phase bus at Public Service of Oklahoma's Southwestern Station. The cylindrical aluminum enclosures provide maximum mechanical strength and electrical protection. Proved Westinghouse design and construction simplify installation, reduce maintenance.

Isolated phase bus provides the ultimate in reliability

The generator terminals at Southwestern Station are tied directly to the main power transformer by Westinghouse isolated phase bus. This is Public Service of Oklahoma's first isolated phase bus installation. It is expected to last the lifetime of the generator and transformer.

The cylindrical aluminum enclosures of the bus are noncorrosive, light weight, and nonmagnetic. This type of construction provides the highest degree of mechanical and electrical protection with complete safety to operating personnel.

Resilient cork-Neoprene gasketed joints seal out dust and moisture. Insulators are designed with extra-large diameter for higher mechanical strength, with deep corrugations for greater creepage distance. The bus is usually factory assembled in large, complete sections for easy installation.

This isolated phase bus installation provides maximum reliability and requires virtually no maintenance.

Automatic operation, low maintenance . . . assure long-term economy

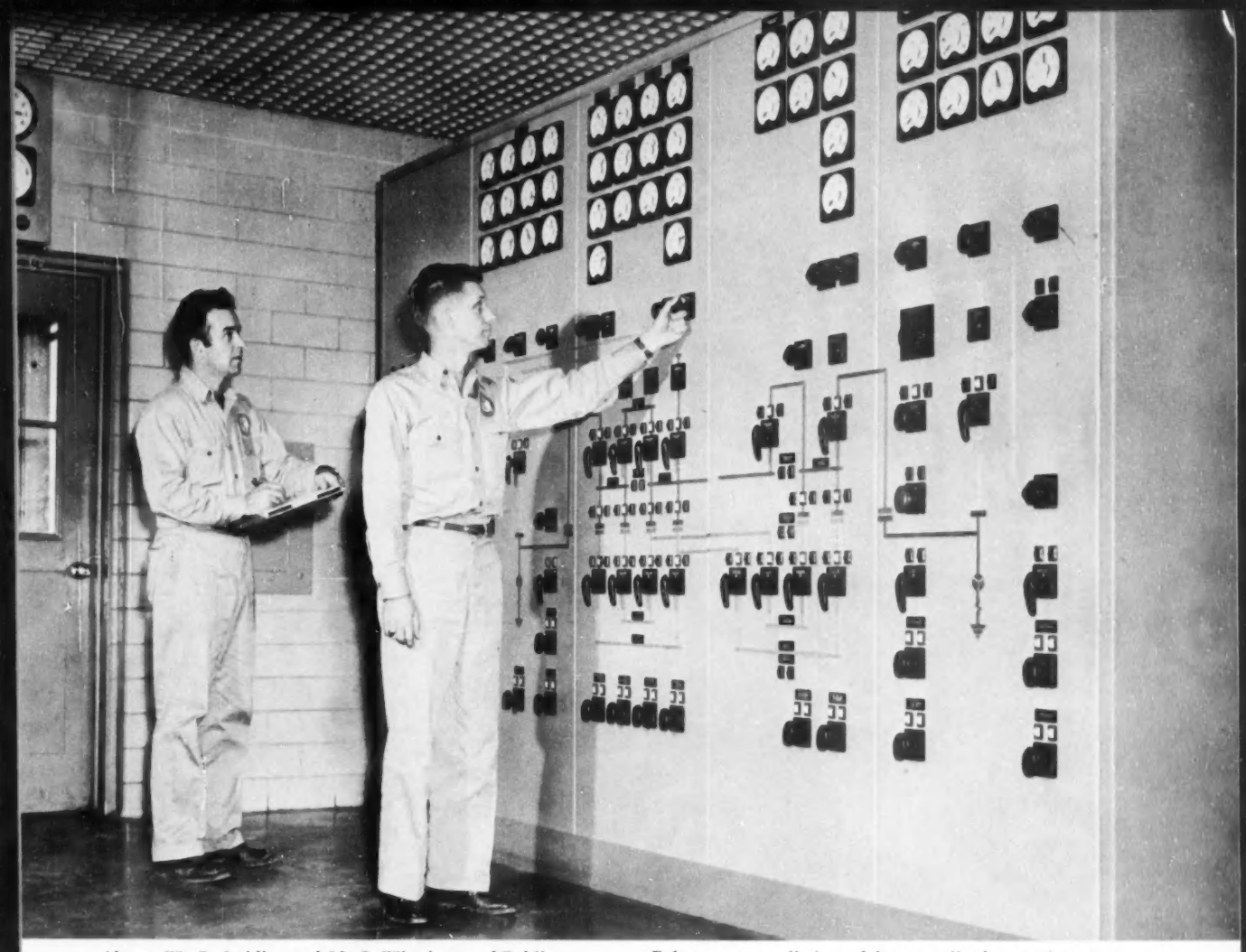
Public Service of Oklahoma, with Sargent and Lundy, carried their imaginative planning all the way through to plant control. One centralized watch station provides all controls . . . mechanical and electrical—for both generation and transmission. The Westinghouse turbine-generator follows this pattern by having throttle and all other controls tied into one central hydraulic control system. This is the main reason why this station requires only four men per shift with a single operator in the control room responsible for the boiler, generator and transmission panels. Maintenance, always expected to be low on such an installation, has been at the unusual minimum of 125 hours down time for the first 12 months of operation. Most of this was for tying in transmission lines and connecting piping.

The standard outdoor specifications of all equipment have increased total costs only a fraction of those required for conventional-type enclosures. Equipment investment and fixed costs were thus reduced and added savings on building maintenance were realized.

The simplicity of operation, minimum maintenance, and improved over-all efficiency at which Unit No. 1 is operating, are attributed in part to the excellent planning and "start-to-finish" cooperation of the utility personnel and local Westinghouse engineers.

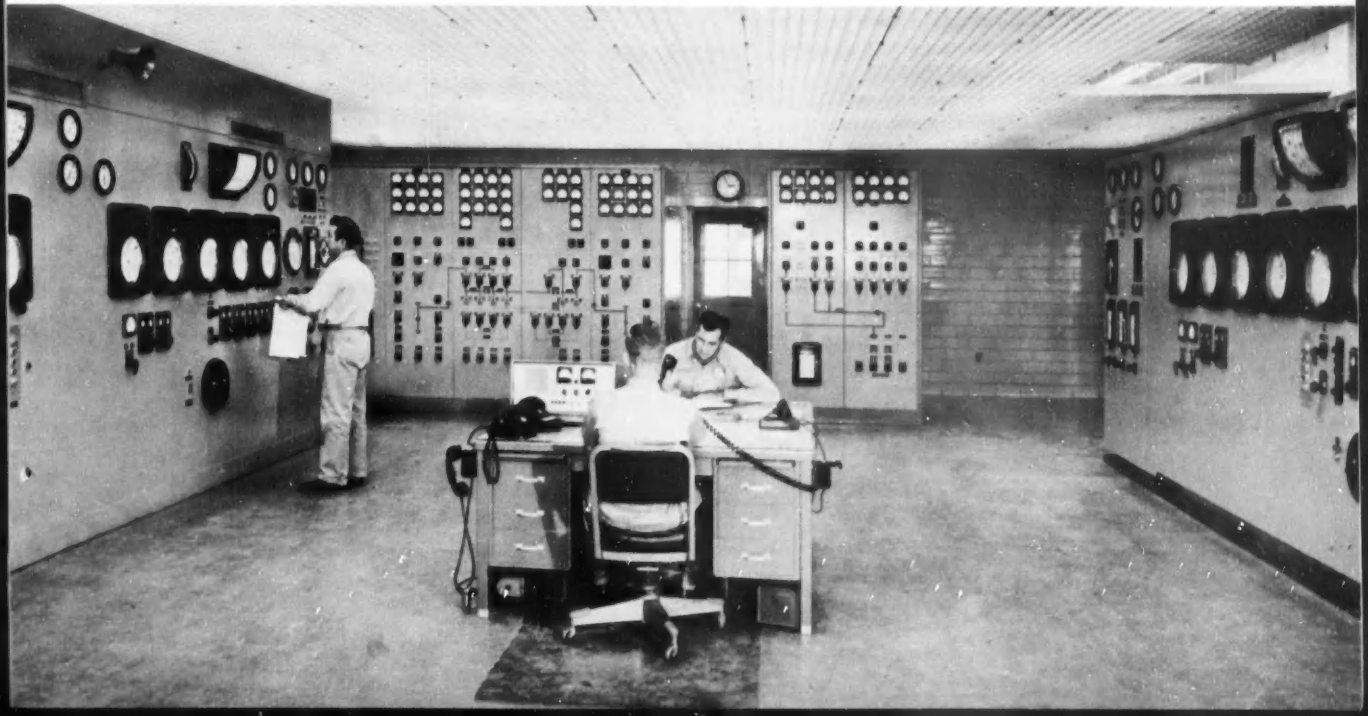
To us, the installation of Southwestern Station has established a new high in cooperative engineering and development for highest over-all results to utility, supplier and the community served.

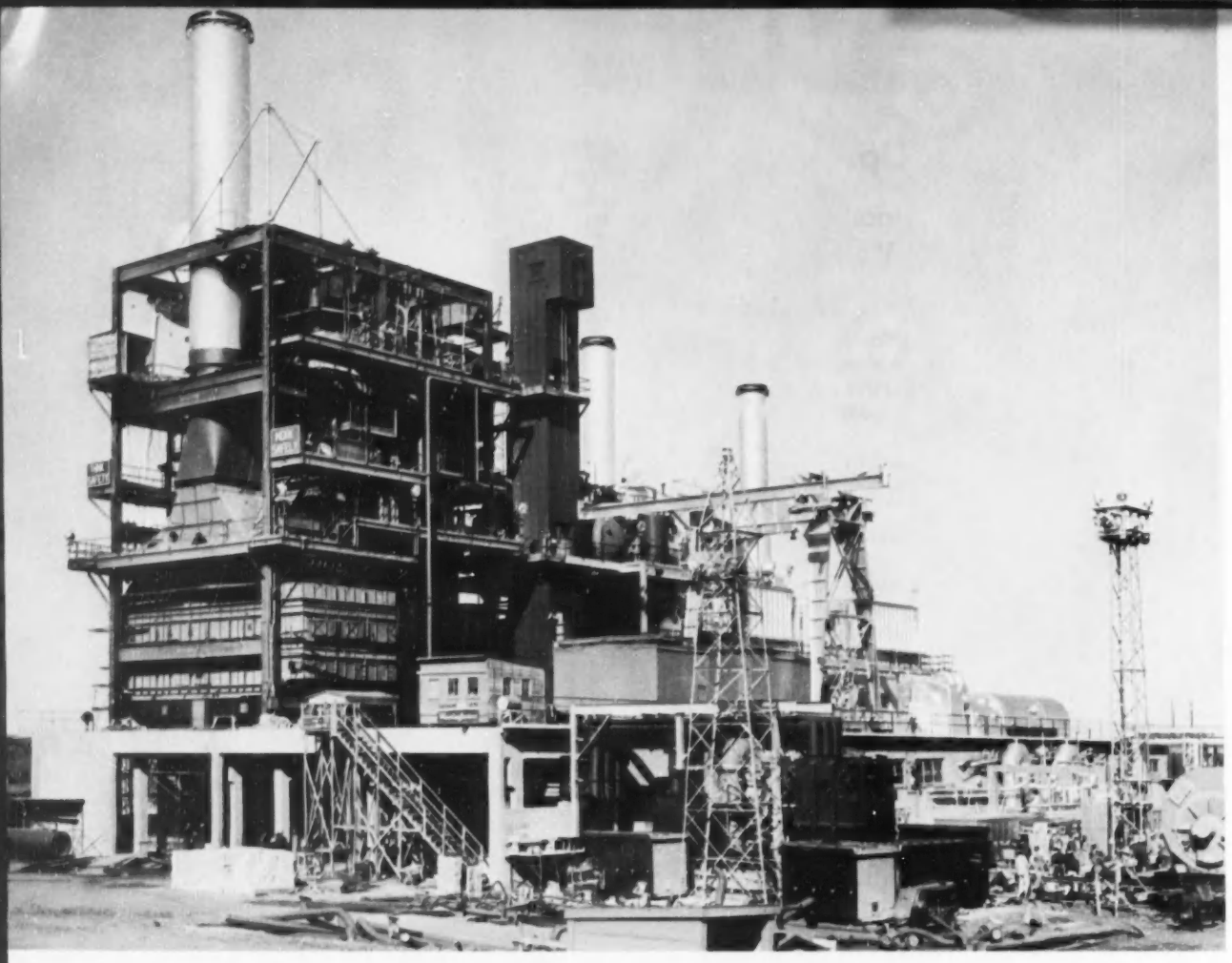
YOU CAN BE SURE...IF IT'S Westinghouse



Above, W. G. Steidley and M. C. Wigginton of Public Service take a reading of the K-24 instruments on the Westinghouse control panel. The latest in optical improvement makes these instruments readable from as far back as 20 feet or at angles as great as 65 degrees. The glare-proof dial is never obscured by shadows.

Below, an over-all view of the centralized control room at Southwestern Station. Control, indicating, recording, regulating and protective equipment is mounted on factory assembled and tested Westinghouse duplex switchboards. The latest in modern designs are utilized for simplicity of operation and attractiveness.





Unit No. 2—"on the line" March 15, 1954

Unit No. 2 at Southwestern Station, shown above under construction, went into operation March 15. It utilized the same basic techniques proved so successful with Unit No. 1.

The only variation was that Unit No. 2 employed a single large boiler instead of the two used for Unit No. 1. Cost was relatively the same.

With the addition of Unit No. 2, Southwestern Station became a very substantial element in the planning of Public Service of Oklahoma to meet rapidly growing loads which are characteristic of the area.

The experience gained at Southwestern has proved conclusively the many advantages to be realized through maximum coordination of both equipment and man power.

YOU CAN BE SURE...IF IT'S Westinghouse

CP-1016

Here's detailed information. Your local Westinghouse representative has this literature at his finger tips—ask for it. Or, if you prefer, fill in the coupon and mail to Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

Name.....

Title.....

Company.....

Street.....

City.....

State.....

Gentlemen: Please send literature checked below:

- ☐ Turbine-Generators (Insulation).....B-6107
- ☐ Condensers.....B-4350
- ☐ Feedwater heaters.....B-5653
- ☐ Powerhouse motors.....B-4731
- ☐ New Life-Line "A" motors...B-6154
- ☐ Motor controls.....B-6051
- ☐ Power transformers.....B-5914, B-4142-A
- ☐ Instrument transformers.....PL45-000
- ☐ Metal-clad switchgear.....B-5306-A
- ☐ Isolated phase bus.....B-5906
- ☐ Power circuit breakers.....B-5904, B-5834
- ☐ Switchboards.....DB-32-500
- ☐ Instruments.....B-4696

CP-1016

Japan's Exports Up

Fiscal 1953 sees electrical equipment at $10 million; 1954 seen nearing $15 million

TOKYO—(McGraw-Hill World News)—Japan's export of machineries during fiscal year 1953 (through March 1954) jumped to $209,178,242 from preceding year's $100,871,060, as shown by a survey conducted by Ministry of International Trade and Industry.

Among major items and amount are: electrical equipment $9,971,779, internal combustion engines $3,943,536, and communications equipment $3,150,844.

Machinery manufacturers are becoming increasingly active in exports. The Ministry of International Trade and Industry expects fiscal 1954 exports of $10 million in heavy electrical equipment and $4 million in light electrical equipment.

Hitachi Ltd was a successful bidder for equipment for Argentine's 8,500-kva Rio Corat power station worth $1,740,000. Mitsubishi Electric Machinery Co outbid Siemens and Algemeine Elektrieschen Gesellschaft of Germany for export of 12,000 integrating watt-hour meters to Formosa. Fuji Electric Machinery Co received an order for 28,000 watt-hour meters from a Turkish trader at $3.50 fob each.

Southeast Asia Activity . . . Japanese manufacturers are also active in technical assistance for Southeast Asian countries. Tokyo-Shibaura Engineering Works set up a joint firm with Remco Co of India for manufacture of 5,000 watt-hour meters monthly. The same company exported equipment worth $832,000 for manufacture of electric bulbs and fluorescent lamps to Bengal Electric Lamp Works and concluded an assistance-for-royalties contract. Fuji Electric Machinery Co exported complete equipment for watt-hour meter manufacture to Kamany Co of India.

Pres Yutaka Kubota of Land Development Co won a contract with the Burmese Government for technical consulting works for Burma's electric power development program.

First Power Cost Computer Shipped

The "Early Bird," claimed to be the world's first electronic computer which automatically calculates the cost of power delivered by each generating station in a complex interconnected system, is shown being shipped from the Philadelphia plant of Leeds & Northrup Co. To be located in Birmingham Ala., the computer will be used by the power supply coordinator to supervise loading of generating stations on the Southern Co System which includes Alabama Power Co, Georgia Power Co, and Gulf Power Co, and Mississippi Power Co. Nicknamed the "Early Bird" for E. D. Early, manager of the Southern Co Power pool, who conceived the idea, the device takes into account fuel costs at each station, associated transmission losses, and generating costs in arriving at the ultimate cost of delivered power.

Management-Research Center Planned by GE

Plans of the General Electric Co to establish a management-research center for executives of all its plants and offices some 20 miles north of New York City in suburban Westchester County became known earlier this month when rezoning was discussed with local officials.

The company intends to use 27 acres in Ossining Township. Eventually, according to a GE spokesman, the company plans to send all its management personnel—from the shop foreman level up to general managers of major departments—through 12-week courses. Executives will sit in on "advanced manager development programs," and will learn "principles of management."

The center would be largely a library and conference place with housing provided for 75 "students."

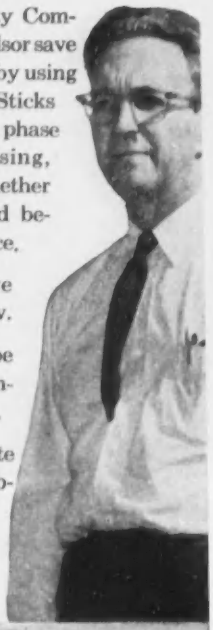
At Valhalla, 15 miles away, GE has a 186-acre site for a proposed national headquarters.

To Produce Armor Rods

Fanner Manufacturing Co, Cleveland Ohio manufacturers of foundry products, has recently entered the field of line hardware with a line of preformed armor rods, according to an announcement by Greif Raible, president. Rods will be made under license by Preformed Line Products Co.

"HIPOT STICKS CUT OUR PHASING TIME 50%!"

says Lloyd Reid, Chief Operator, Windsor Utilities Commission



Canadian Utility Companies like Windsor save countless hours by using Hipot Phasing Sticks for determining phase rotation, phasing, and to detect whether cables are dead before maintenance.

SAFE! on live lines up to 33 Kv.

SIMPLE! can be used by non-technical personnel.

SURE! accurate without disturbances from other circuits.

Hipot PHASING STICKS

GM

Send for Bulletin Today!

CANADIAN LINE MATERIALS LIMITED
TORONTO 13, CANADA

Please send me a copy of your Hipot Phasing Stick Bulletin.

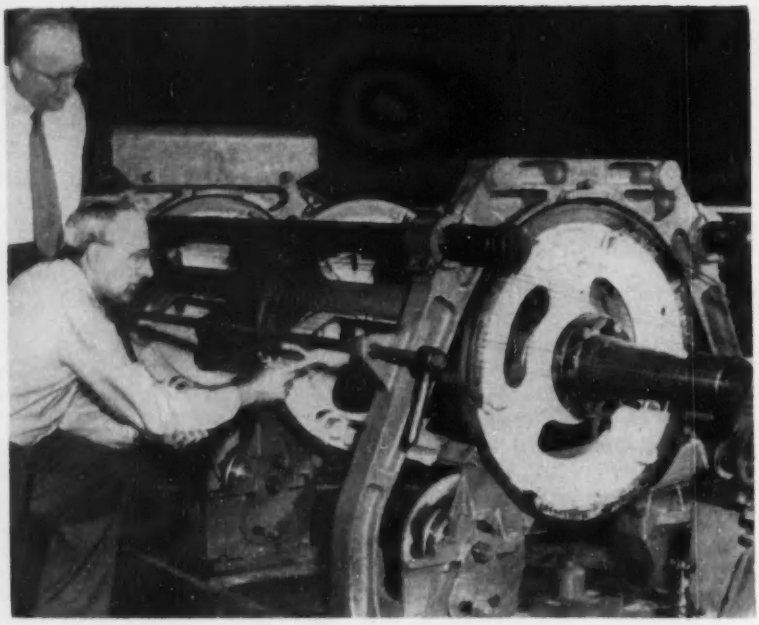
Name.....

Title.....

Company.....

Address.....

City..... State.....



175-Ft High-Speed Strander at Roebling's

Production of flexible wire rope for shovels, cranes, and hoists is accelerated by a new, modern, high-speed wire stranding machine in the Wire Rope Div of John A. Roebling's Sons Corp, a subsidiary of Colorado Fuel and Iron Corp. The 175-ft strander, driven by a 150-hp engine, twists from 26 to 46 separate wires into strands for wire rope up to 1⅝-in. diam. Wire rope made from these strands can lift up to 25-ton loads.

Westinghouse Dedicates Vicksburg Lighting Plant

Lighting Division of Westinghouse has opened its 300,000 sq ft plant south of Vicksburg, Miss. The plant, situated on a 55 acre tract, manufactures fluorescent lighting fixtures, ballasts, and flood lighting equipment for commercial and industrial use. Capacity is 35,000 units per month. Employment will eventually reach 500 to 800 with a $2 million payroll.

This one-story steel and concrete building is one of nine plants built or under construction in the south since the company's $296 million expansion program began in 1950, now 75% completed.

BICC in Australia

MELBOURNE—(McGraw - Hill World News)—British Insulated Callender's Cables has opened a branch in Australia. The Melbourne-situated branch will tender for some of the work connected with the huge Snowy Mountain Hydro-Electric project. The company is at present engaged in a $4 million railway electrification project in New South Wales and has recently installed a 132,000 v underground cable in Sydney. This is claimed to be the only one of its kind in the Southern Hemisphere and one of only two in the world.

Seattle Receives Bids for Turbine, Capacitors

Bids totaling more than $1.4 million have been received by the city purchasing agent at Seattle, Wash., for two electrical equipment contracts.

Newport News Shipbuilding & Drydock Co of Newport News, Va., figured low at $1,146,845 for a hydraulic turbine to be installed in City Light's Ross powerhouse while the Nelson Electric Manufacturing Co was low at $258,136 for outdoor capacitor banks, including six 182-kv lightning arresters.

a new twist ON SAVINGS...

fine FANNER

Superformed ARMOR RODS provide lasting line protection!

as easy as

Two or more individual rods are taken from pack. Note the "spring" in the rods and the smooth ends that result in quick, rugged applications.

Rods are laid against the conductor as a group and then easily turned in a rotary manner around conductor.

More groups of rods are added in the same manner, depending on size of conductor—and the job is done easily—in the matter of minutes!

Now . . . the extensive production facilities of the FANNER plants . . . from the control of the raw materials to the finished product . . . have combined to produce a truly outstanding armor rod. Rigid manufacturing controls and field testing have proved that fine FANNER Armor Rods "work with the lineman" and "work for the line."

Through exclusive methods of fabrication, greater dimensional accuracy is produced in the rod. Stresses and strains that may cause distortion of wire when formed by other methods are eliminated by FANNER'S special preforming process.

As a result, the chance of poor installation is eliminated —no tools, no wrenches, no special skills are required— application time drops to a minimum. Fine FANNER Armor Rods require no end clamps—they hold the line in a vise-like grip, yet can be removed easily and re-used over and over again.

With all their extra qualities and features, fine FANNER Armor Rods cost you no more than ordinary types. They are available in both aluminum and galvanized steel for all sizes of conductors. Each size is made to fit each particular size of conductor.

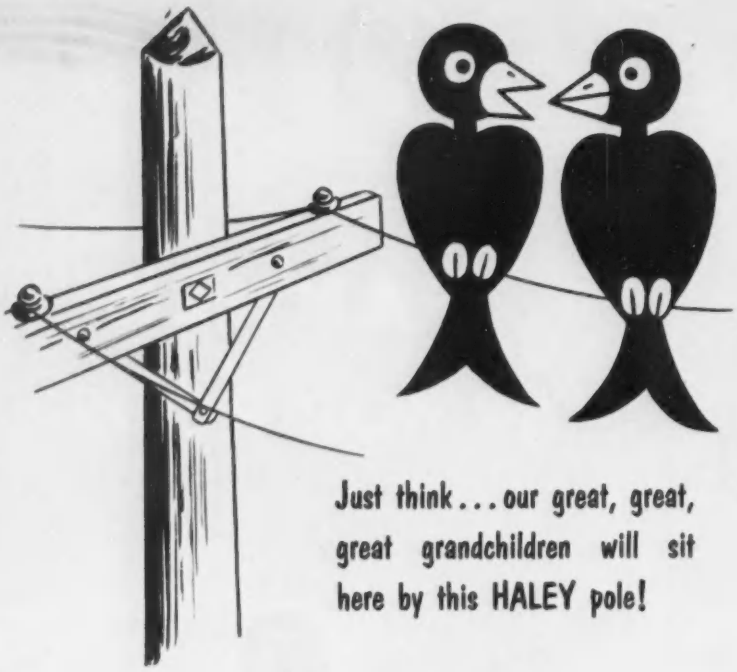
For more complete information and prices on new, fine FANNER Armor Rods, write today.

SALES REPRESENTATIVES WANTED!

● The demand for fine FANNER Superformed ARMOR RODS is growing rapidly because of the greatly expanded use and unlimited applications of armor rods in the electrical field. An exceptional opportunity is offered in several territories to representatives who want to associate themselves with a substantial, recognized company with over 60 years in the manufacturing field. In writing, please cover background of experience in detail.

THE FANNER MANUFACTURING CO.

Brookside Park — Cleveland 9, Ohio



Just think . . . our great, great, great grandchildren will sit here by this HALEY pole!

Haley's PENTAchlorophenol TREATED

CEDAR POLES
AND
FIR CROSS ARMS

Light in weight and clean. PENTAchlorophenol treated in our modern plant for protection against decay, moisture and insect damage.

TWO Strategically Located Yards
MINNEAPOLIS, MINNESOTA
FINDLAY, OHIO

R. G. HALEY & CO.
SPITZER BLDG. TOLEDO 4, OHIO

Three other bids for the turbine ranged up to $1,290,000 while six other proposals for the capacitor banks went as high as $350,498.

Wire-Rod Mill Built

A new merchant mill capable of producing 36 million lb of aluminum merchant wire, rod, and bar products annually has been completed at Sheffield, Ala., it has been announced by J. Louis Reynolds, vice-president of the Reynolds Metal Co. The new mill which cost approximately $1.75 million, will be operated by Reynolds Alloys Co.

The new mill, with 130,000 sq ft of floor space, will produce rod products up to 2.0-in. dia and wire down to approximately 0.092-in. dia in either coiled or straightened lengths. A complete line of rectangles, squares, hexagons, angles, and flattened wire can be produced. Above is shown a wire drawing operation. The new plant approximately doubles Reynolds' capacity to produce merchant type products and permits the company's structural mill to double its capacity for large rod and structural shapes.

Chilean Copper Piled

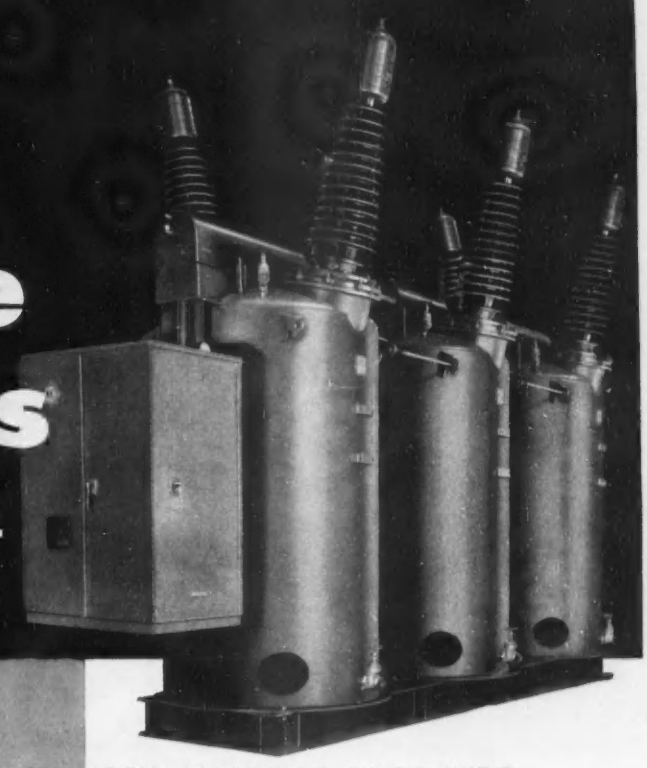
The national stockpile will be increased by 100,000 tons of Chilean copper, priced at 30¢ a lb for cathode copper delivered to storage point. Part of the copper is in the U. S. and will be transferred to the stockpile at once.

A contract has been signed with

ALLIS-CHALMERS
PROGRESS IN
Switchgear

compare breakers

get the breaker with ALL the important features



HERE'S A COMPARISON OF HIGH VOLTAGE BREAKERS

FEATURES	Allis-Chalmers Breaker	Breaker X	Breaker Y	Breaker Z
Pneumatic Operator	Yes	Yes	Yes	No
Mechanically trip-free	Yes	No	Only first operation	*
Electrically trip-free	Yes	Yes	Yes	*
Hydraulic Operator	Yes	No	No	Yes
Mechanically trip-free	Yes	*	*	No
Electrically trip-free	Yes	*	*	Yes
Electrically Tested —				
Laboratory	Yes	Yes	Yes	No
Field	Yes	Yes	Yes	Yes

*Not Applicable

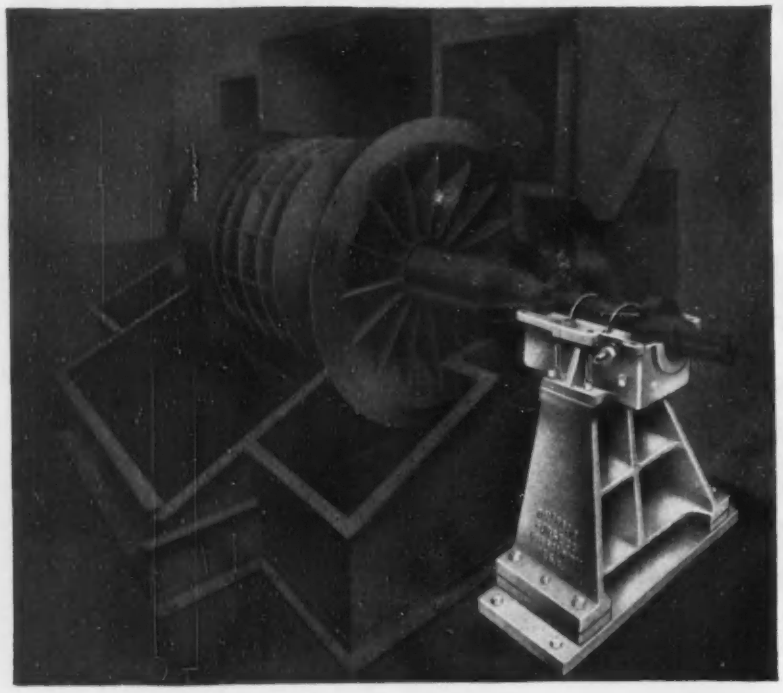
Allis-Chalmers reliable breaker performance is based on more than 50 years of circuit breaker design, manufacturing and field experience.

Get complete engineering information! Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4290

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

HOW A BEARING
HELPS PRODUCE CHEAPER POWER



. . . in "Buffalo" Induced Draft Fans

In the punishing induced draft job, every part of the fan that contributes to longer life and freedom from troubles, is helping to cut your power-production costs.

The "Buffalo" water-cooled self-aligning bearing is built to stand heat and continuous, extremely heavy load. The sole plate, pedestal and bearing housing are oversize and completely rigid. Both bearing liner halves are water-cooled. The oil reservoir is extra-large. The self-aligning water-cooled liners are easily removable for servicing operations, without disturbing pedestal, shaft or rotor.

In fact, all parts of "Buffalo" Draft Fans are of equally sturdy, accessible construction—housings, shafts and rotors. This construction is not cheap; it is in line with the "Buffalo" "Q" Factor* which in installation after installation has saved users money through added years of performance on the job. For further information, write today for Bulletin 3750.

"Buffalo"

** The "Q" Factor — The built-in Quality which provides trouble-free satisfaction and long life.*

BUFFALO FORGE COMPANY
212 MORTIMER STREET BUFFALO, N. Y.
Publishers of "Fan Engineering" Handbook
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING FORCED DRAFT AIR CLEANING COOLING AIR TEMPERING HEATING INDUCED DRAFT PRESSURE BLOWING EXHAUSTING

Anaconda Sales Co for 64,000 tons. Kennecott Sales Corp will sign for 36,000 tons.

The House last week unanimously approved a bill to extend for two years after June 30 a suspension on a 2¢ per lb additional import tax on copper. The measure now goes to the Senate. The bill contains a clause under which the President could reimpose the tax if average copper prices fall below 24¢ per lb for 30 days.

SALES ASSIGNMENTS

COMPANY STAFFS

Bailey Meter Co's Philadelphia District office has been moved to larger quarters at 29 Bala Ave., Bala Cynwyd, Pa. H. C. Tanner will handle the managership of that office which covers the territory of eastern Pennsylvania, southern New Jersey, Delaware, central and eastern Maryland, Washington, D. C., and central and eastern portions of Virginia.

Wagner Electric Corp. St. Louis, has announced that new location for its Los Angeles (Calif.) branch office and warehouse operations is at 614 Lairport St. in El Segundo. L. G. Tandberg is manager of the electrical branch office, whose operations embrace southern California, Arizona, and part of Nevada.

Reliance Electric & Engineering Co, Cleveland, has appointed H. Bigelow Moore as a sales application engineer to the staff of the Philadelphia district sales office. Moore joined Reliance last November after serving with Nickel Cadmium Battery Co.

Allis-Chalmers Manufacturing Co, Milwaukee, named two regional representatives for steam turbines and power plant equipment. C. C. Jordan will cover the Northwest and Midwest regions from his headquarters in the Milwaukee district office. W. B. Tucker was assigned to the Central regional office at Cleveland. Both Jordan and Tucker joined A-C in 1923.

Graybar Electric Co, New York, has named J. L. Bevers manager of the Wichita branch to replace E. F. Linnerson, who has been transferred to Kansas City. Bevers, with the firm since 1940, has been manager of outside construction sales at Kansas City for the past five years.

Babcock & Wilcox Co's Tubular Products Division has appointed Henry W. Doctor as district sales manager of the newly established sales office in Cincinnati, Ohio. Territory of the new district office includes southern Ohio, southern Indiana, Kentucky, Tennessee, Alabama, Georgia, South and North Carolina, and Florida. Since joining the firm in 1933, Doctor has served the division's Beaver Falls, Pa., general sales office as manager.

Owens-Corning Fiberglas Corp, Toledo, has made Howard G. Ervin, Jr, manager of its Cincinnati branch office. Ervin, associated with Owens-Corning since 1947, succeeds F. Gilbert Baechle, Cincinnati branch manager since 1941, who has resigned.

(*Meetings Calendar on page* 130)

AMCRECO provides

Amcreco *Lowry Process* **Creosoted Products**

CROSS TIES • BRIDGE TIES • PILES •
FRAMED BRIDGE TIMBERS • POLES •
CONDUIT • PLANKING • CROSSARMS

In an industry where so much depends on service, Amcreco offers facilities second to none. But even more important, these facilities are backed by wood preserving experience and know-how that results from nearly half-a-century's intensive study and research into wood preserving methods and problems.

Your requirements for treated materials can best be filled by an organization with the facilities and experience to provide you with efficient service and proved treatment and whose plants are strategically located for prompt domestic or export shipment. East of the Rockies, that means Amcreco. We hope to have the opportunity to quote on your needs.

AMERICAN CREOSOTING COMPANY

COLONIAL CREOSOTING COMPANY INCORPORATED — AMCRECO LOWRY PROCESS CREOSOTED WOOD — GEORGIA CREOSOTING COMPANY INCORPORATED

GENERAL SALES OFFICE—CHICAGO, ILLINOIS
18 FIELD SALES OFFICES TO SERVE YOU

Now...Kennecott joins your fight for adequate wiring of America's homes!

Something important is going to happen about this inadequate residential wiring problem of yours!

Look at the advertisement on the opposite page. It's the opening gun of a great, new adequate wiring campaign sponsored by Kennecott Copper Corporation.

Reaching over 15,130,000 readers of the Saturday Evening Post and This Week *every month*, this Kennecott campaign takes dead aim at the heart of the problem of overloaded inadequate wiring that prevails in over 80% of the Nation's homes!

In easy-to-understand, untechnical words, the advertisements of this Kennecott campaign tell homeowners and home planners how to recognize the symptoms of inadequate wiring and what to do about them. It's an educational campaign bound to benefit *everyone* in the electrical industry!

Want To Tie In?

Would you like to key your own local promotions to this Kennecott campaign?

Would you like to have reprints of the advertisements?

Write Kennecott! Address your letter to Carl Lenz, President, Kennecott Sales Corporation, 161 East 42nd St., New York 17, New York.

Let's work together for adequate wiring!

Why couldn't it do that before?

What *WAS* the matter with this lady's toaster? Nothing at all. It just wasn't getting the *power* it needed!

Why not? Simply because the *wiring* in the lady's house wasn't large enough to carry the necessary *electricity* to her toaster as well as to the many other appliances she uses.

But, as you can see from the lady's face, she did something about it. So can *you*, if your house is suffering from the same electrical troubles. *And it's 4 to 1 that it is!*

For instance, if your home was built more than 10 years ago, you can be positive that its original wiring cannot care for all the appliances you've bought these past few years. *In fact, even a brand-new house may be electrically unfit to handle the load of all the appliances you now own!*

How can you tell if your home wiring needs attention? In addition to poorly-operating appliances: Dimming of lights when you operate appliances; Slow heating of toaster, iron, etc.; Frequent blowing of fuses; Poor TV reception when appliances are in use; Too few outlets and switches where you need them.

If you find these symptoms in your home, you can be sure that you are putting up with more than *inconvenience*. You're also *losing money* in wasted current. You're *risking fire* from under-sized, overloaded, overheated wires!

Why take chances? Ask your local electrician for an electrical check-up!

Look To Your Electricity!

✓ **If you own a house,** see your electrician. He will gladly make a study of your wiring system, tell you what work if any may be needed, and its cost.

✓ **If you plan to buy a house,** don't forget to check up on the age and capacity of its wiring. Better still, have an electrician inspect it for you!

✓ **If you are going to build,** be sure to plan your wiring for the *future* as well as the present. Remember that on the average, your electrical needs increase 10% every year!

Kennecott Copper Corporation,
161 E. 42nd St., New York 17, N. Y.

Fabricating Subsidiaries:
Chase Brass & Copper Co.
Kennecott Wire & Cable Co.

Published for your information by

Kennecott
COPPER CORPORATION

This advertisement will appear, with a circulation of 15,130,000, in the Saturday Evening Post and in This Week. Other Kennecott advertisements will also feature adequate wiring to architects and builders.

Quick, dependable carrier measurements—3 to 500 kc

New Model 104 Carrier Frequency Voltmeter—5 to 150 kc

Four Frequency-Selective Voltmeters

Four precision frequency-selective voltmeters for carrier system measurements are now offered by Sierra. Including the new Model 104, these instruments cover all frequencies 3 to 500 kc. They provide a fast, accurate means of measuring voltages in telephone, telegraph, telemetering and control circuits. They also make possible quick, dependable tracing of circuit faults. All four instruments have direct reading meters calibrated in dbm from − 20 to + 2 dbm on the meter and −60 to + 40 dbm on the range changing attenuator. All contain a built-in calibration oscillator and a VTVM for swift, simple calibration. **For details, request Bulletin 107.** *(For wave analysis and harmonic studies 15 to 500 kc, Sierra offers Model 121 Wave Analyzer. Request Bulletin 103).*

SPECIFICATIONS

Model No.	Frequency Range—kc	Input Level Range—dbm	Selectivity		Direct Reading in dbm	
			Down 3 db	Down 45 db	Balanced	Unbalanced
101A	20—500	−80 to + 42	± 750 cps	± 6000 cps	*	600 ohms
103A†	3—40	−80 to + 42	± 400 cps	± 3000 cps	**	600 ohms
104	5—150	−80 to + 42	± 300 cps	± 1500 cps	**	600 ohms
108A	15—500	−80 to + 42	± 600 cps	± 3000 cps	135 ohms*	600 ohms

*May be converted for 135, 500 or 600 ohm balanced line measurements with Sierra 122 Line-Bridging Transformer. (Low cost, plug-in unit). **Same as 101A except uses Model 155 Transformer. †Contains carrier re-insertion oscillator for monitoring single side band suppressed carrier systems. Data subject to change without notice.

sierra

Sierra Electronic Corporation
San Carlos 2, California, U. S. A.
Sales representatives in major cities
Manufacturers of Carrier Frequency Voltmeters, Wave Analyzers, Line Fault Analyzers, Directional Couplers, Wideband RF Transformers, Custom Radio Transmitters, VHF-UHF Detectors, Variable Impedance Wattmeters, Reflection Coefficient Meters.

MEETINGS CALENDAR

Public Information Program
Steering Committee, Traymore Hotel, Atlantic City, N. J., June 1; West North Central Region, Hotel Superior, Superior, Wis., June 11; East North Central Region, Dearborn Inn, Dearborn, Mich., June 25; Workshop Conference, Chase Park Plaza Hotel, St. Louis, Oct. 28-29.

Edison Electric Institute
22nd Annual Convention, Atlantic City, N. J., June 1-4; Accident Prevention Committee, Mark Hopkins Hotel, San Francisco, July 1-3; Industrial Relations Committee, Round-Table, Conference, Palmer House, Chicago, Sept. 27-29.

National Association of Electrical Distributors
Annual Convention, Atlantic City, N. J., June 6-11; Pacific Zone Convention, Mark Hopkins Hotel, San Francisco, Oct. 4-7.

American Society of Engineering Education
62nd Annual Meeting, University of Illinois, Urbana, Ill., June 14-18.

Illuminating Engineering Society
Midwestern Regional Meeting, Hotel Jefferson, St. Louis, June 17-19; National Technical Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., Sept. 12-16.

American Society of Mechanical Engineers
Semi-Annual Meeting, William Penn Hotel, Pittsburgh, June 20-24; Fall Meeting, Schroeder Hotel, Milwaukee, Wis., Sept. 8-10.

Nuclear Engineering Conference
Sponsored by American Institute of Chemical Engineers, University of Michigan, Ann Arbor, Mich., June 20-26.

American Institute of Electrical Engineers
Summer General and Pacific General Meeting, Hotel Biltmore, Los Angeles, June 21-25; Committee on Petroleum, Conference on Electrical Applications in Petroleum Industry, Mayo Hotel, Tulsa, Okla., Sept. 27-29; Middle Eastern District Meeting, Abraham Lincoln Hotel, Reading, Pa., Oct. 5-7; Fall General Meeting, Morrison Hotel, Chicago, Oct. 11-15.

Canadian Electrical Association
Annual Convention, Murray Bay, Quebec, June 24-26.

Michigan Electrical Association
Annual Convention, Grand Hotel, Mackinac Island, Mich., June 27-30.

Northwest Electric Light & Power Association
Personnel Section with EEI Industrial Relations Committee, Multonah Hotel, Portland, Ore., July 12-14.

World Power Conference
Sectional Meeting, Rio de Janeiro, Brazil, July 25-Aug. 10.

Pan-American Federation of Engineering Societies
(UPADI), Third Convention, Sao Paulo, Brazil, Aug. 2-12.

Public Utilities Association of Virginia
36th Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va., Sept. 16-18.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., Oct. 6-8.

Interstate Power Club
Meetings will be held at Hotel Martinique, New York, on following dates: Oct. 11, Dec. 6.

***National Electrical Manufacturers Association**
Haddon Hall Hotel, Atlantic City, N. J., Nov. 8-11.

*Addition this week.

Let **HOMELITE** do it...

Any time it comes to pumping out manholes, a Homelite pump is really tops. Small and compact, it fits snugly in even the smallest truck. *And when needed* . . . one man picks it up and carries it easily to any place where needed.

Quick starting . . . fast self-priming . . . (a Homelite starts pumping instantly) at the rate of 15,000 gallons per hour. Yes, and when it comes to seepage, a Homelite keeps it right at strainer level always, automatically.

Non-clogging, weatherproof, dustproof . . . and with a guaranteed suction lift of 28 feet . . . a Homelite carryable pump will give you years of dependable service, on even the toughest jobs.

Write for a free demonstration.

Manufacturers of Homelite
Carryable Pumps
Generators • Blowers
Chain Saws

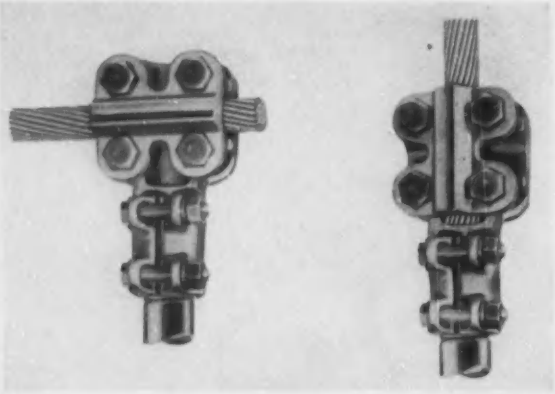
PERFORMANCE · DEPENDABILITY · SERVICE

HOMELITE

CORPORATION

6105 RIVERDALE AVENUE • PORT CHESTER, N. Y.

NEW EQUIPMENT



Stud Connectors

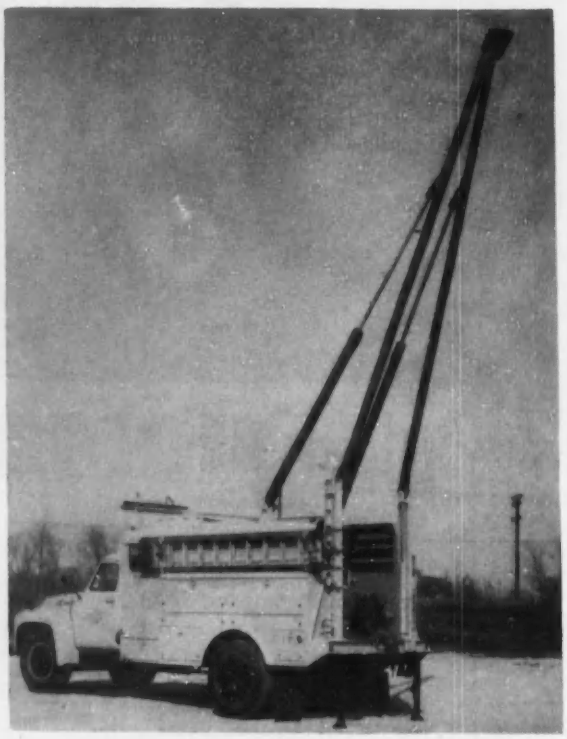
Stud connectors, Universal Type DSCT, are used with tubing and cable for straight or 90-deg connections. Clamping cap is square, permitting 90-deg rotation or reversal, thus providing copper cable range of 2 AWG solid to 800 Mcm and copper tubing range from ⅜-in. to ¾-in. IPS. Seven stud sizes cover ½-1½-in. diam range. Connector is cast electrical bronze and furnished with hex-head silicon-bronze bolts, nuts, and lockwashers.

Anderson Brass Works, Inc, 700 N. 41 St, Birmingham, Ala.

Hydraulic Derrick

Hydraulic derrick, Series HD-4-70 Pole-Master, handles poles up to 75 ft long and mounts on vehicles of 22,000-lb gvw or more. Derrick movement through nearly 180 deg arc is actuated by two pairs of hydraulic cylinders driven by transmission power take-off. Controls are located in a rear compartment of body. Used with a single-drum winch, derrick will lift loads to any position in body cargo area. Boom stows over cab for traveling. Capacity is 9,000 lb with sheave 5 ft to rear of side-leg pivot points. Complete details in Bulletin 407.

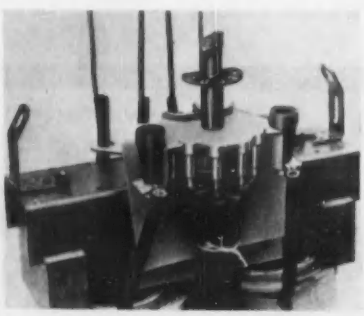
McCabe-Powers Auto Body Co, 5900 N. Broadway, St. Louis 15, Mo.



Tap Changer ⟶

Round-wound distribution transformers rated 100 kva and smaller have a new tap changer. Alkyd-resin glass-fiber-reinforced body has high mechanical and electrical strength and stability over wide range of temperature. Features include elimination of live parts on upper surface of body, and large terminal knobs.

Line Material Co, Milwaukee 1, Wis.

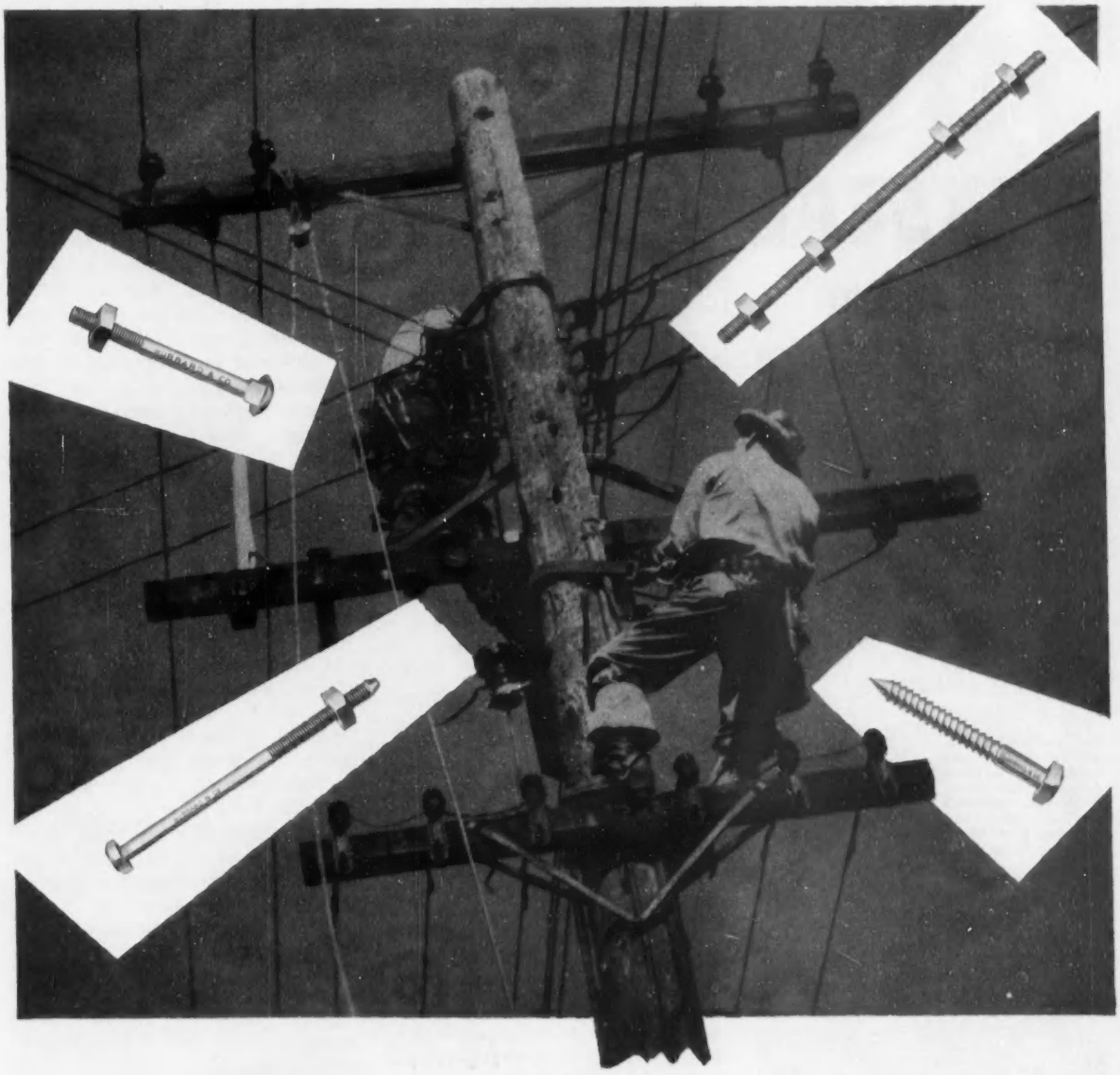


Hazardous-Location Starters

Volt-ampere-limitor type of Class I Group D motor starters provide overall short circuit protection for 2,200-5,000-v motors. They limit maximum fault current to 25,000-kva steady-state current. Type ZHS magnetic contactors used have 50,000-kva interrupting capacity.

For maximum protection against

HOLD EVERYTHING!



with HUBBARD Hardware

Machine bolts, carriage bolts, double arming bolts, and lag screws—the workaday items of the electrical industry—are specially designed by Hubbard with careful attention to the functions which they must serve.

All crossarm and double arming bolts have the original Hubbard DRIVEPOINT feature. All bolts and lag screws are formed from new open hearth steel and are Hubbard Double-Dip Hot Galvanized. Special care is used to keep threads clean and smooth during galvanizing.

If it's Hubbard, it's made to serve efficiently.

HUBBARD AND COMPANY

ESTABLISHED 1843

PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

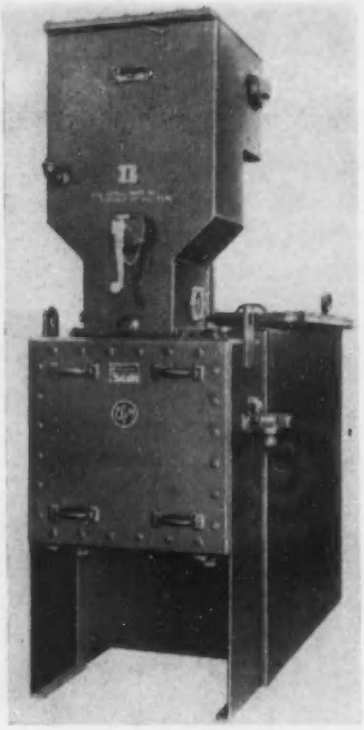
HANDY ANDY SAYS,

DUXSEAL®
plugs 'em easier-and better!

Duxseal is a nonhardening adhesive plastic compound made with an asbestos base. Stays plastic, will not slump, melt or run under ordinary temperatures. Clings to duct walls and cables but flexes with expansion and contraction. Unaffected by water and gases—does not react with rubber, metals or painted surfaces. For full details write Johns-Manville Box 60, New York City 16; in Canada, 199 Bay St., Toronto 1, Ontario.

Duxseal is a general utility sealing and caulking compound for duct openings, potheads, bushings and terminal boxes. Use like putty as it comes from the package

Johns-Manville
SEALING COMPOUNDS



explosion, all connections, terminals, arcing parts, and main-line disconnect switches are oil-immersed. Starters are usable with high-inrush motors. Thermal capacity allows frequent starting of motors.

Electric Controller & Manufacturing Co, 2729 E. 79th St, Cleveland 4, Ohio

Crane Control

Instead of standard 5 speeds, overhead cranes equipped with Selectodyne control have 11 instantly-selectable speeds in each direction. Forward-backward motion of a single lever changes the hook direction, and left-right motion changes the speed. Control is available with automatic load brake, and on new or for old cranes. Details are in Bulletin Section 300, Unit 78.

Whiting Corp, Harvey, Ill.

Solderless Terminals

Solderless terminal lugs are for indoor or outdoor use, and have either hexagon- or socket-head screws. Heavy high-strength bronze castings have machined tangs. Lugs have two mounting holes.

For single conductor, the Multimount comes in 4 sizes for wire 4 AWG to 1,000 Mcm. The Twinlug is double barreled to take two parallel conductors. Three sizes cover range 1/0 to 1,000 Mcm.

Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

Metering

Metering outfits rated up to 200/400 amp, 25-69 kv, are equipped with ratio changing arrangement for de-energized operation with an outside handle. Ratio changer can be operated from ground level, or floor level in substation yards, eliminating time-consuming terminal link changes. Self-aligning contacts have equal and positive pressure—round contact against flat contact establishes only one current path.

Allis-Chalmers Manufacturing Co, 930 S. 70th St, Milwaukee 1, Wis.

Chain Hoist

Chain-type hoist, rated 1 ton, has aluminum housing and handle and a hardened-steel shaft. Controls can be operated without removing work gloves. A control lever places chain in "free-wheeling." This lever automatically locks when pulling, so load cannot be accidentally dropped. Flexible steel chain will not kink or uncouple and can be operated with either half- or full-link take-up.

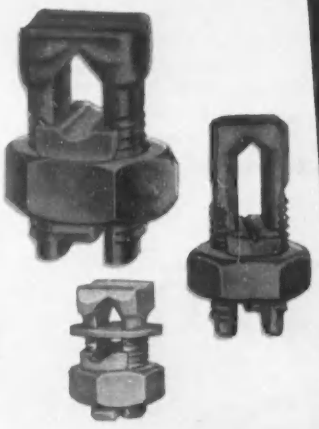
A. B. Chance Co, 210 N. Allen St, Centralia, Mo.

Ground Clamp

Ground clamp, Type GC, for parallel cable connection to rod or pipe, has high-strength cast bronze-alloy body.

Get higher conductivity

PLUS PERMANENT TIGHTNESS WITH MATTHEWS SPLIT-BOLT CONNECTORS



Matthews Split-Bolt Connectors, forged from medium drawn copper, have the same characteristics as the conductor itself. That's why you get high conductivity that reduces line heating, conductor damage, radio and TV interference, and the damaging effect of overloads.

You can screw these split-bolts up tight enough to stay tight without smashing the conductor in a vise-like grip. Torque wrench tests prove that connections made with Matthews Split-Bolts *stay tight* over longer periods of time because both clamp and conductor have the same coefficient of expansion.

Pad swings clear while installing clamp on conductor.

For larger conductors...

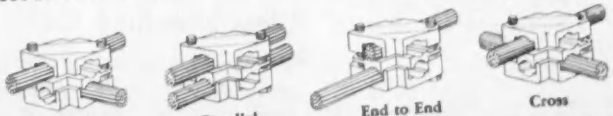
USE THE EASY-TO-APPLY...LOW COST MATTHEWS UNICLAMP

For 1/0 through 1,000 MCM conductor you can save money and get a better, more easily applied connection with Matthews Uniclamps. They cost less than split-bolts in these larger sizes, and they give you a wider contact area plus the extra strength needed on large stranded conductors. Linemen like Uniclamps because they can be installed without taking them apart, and their shape makes them easy to cover with protective tape.

Three sizes are all you need

WHEN YOU USE MATTHEWS MULTITAPS

Substation connections, grounding grids or industrial wiring jobs that call for a wide variety of taps can usually be handled with Matthews Multitaps. These versatile connectors can be used for cross, T, end to end, and parallel connections. The three sizes will accommodate a wire range from #1 stranded up to 1000 MCM on the main line side, and #6 solid to 1000 MCM stranded on the tap side. Multitaps are cast of high strength copper alloy. They have rounded corners for easy taping.



T Connection | Parallel | End to End | Cross

A·B·CHANCE CO·

CENTRALIA, MISSOURI · SAN FRANCISCO, CALIFORNIA

CC54-13

Square-head bolt is silicon bronze. For insurance against stress corrosion and seasonal cracking, clamps meet ASTM B-154-51 and ABW 124-2 specifications. Sizes are ½, ⅝, and ¾ in.
Anderson Brass Works, Inc, 700 N. 41 St, Birmingham, Ala.

Reel

Squirrel-cage pay-out reel, No. 700, will handle stiff wire such as aluminum service wire, galvanized strand, or messenger cable. Reel can be mounted vertically or used horizontally. Steel, electrically welded reel can be furnished with stationary or adjustable pins for various sizes of coils.
Neal Co, 2806 Leavenworth St, Omaha, Nebr.

Substation Transformers

Unit substation, or load center, transformers are rated through 10,000 kva and 72 kv. High-voltage fused cutouts or switches and low-voltage circuit breakers or switches form integral parts of these Type HT transformers without any throat connection. Units are designed for either indoor or outdoor use, and are either liquid or dry type.
Standard Transformer Co, Warren, Ohio

Open-Type Cutouts

Line of 100-amp open-type distribution cutouts, Type HDO, have standard-, intermediate-, or heavy-duty fuse cartridge and optional load-break device. Cartridge assemblies have interrupting capacities of 3,000, 5,000, or 10,000 amp at 5.2 and 7.8 kv; and 2,000, 4000, or 8,000 amp at 15 kv.

Hardware is a corrosion-resistant steel with claimed life of 4 to 6 times that of mild steel. Cutouts are available with 200-amp switch blades and with single, post-type, or BIL insulator mounting.
Line Material Co, 700 W. Michigan St, Milwaukee 1, Wis.

Wheatstone Bridge

Measuring bridge, Type ZK, has single knob for covering six ranges, 40 milliohms to 50,000 ohms. Reading is directly in ohms—scales change automatically when knob is turned. Bakelite bridge in leather carrying case weighs 4 lb. Details in Bulletin 630.
Herman H. Sticht Co, Inc, 27 Park Pl, New York, N. Y.

Coming New Equipment

Received Too Late for This Issue

A-Frame Storage Kit

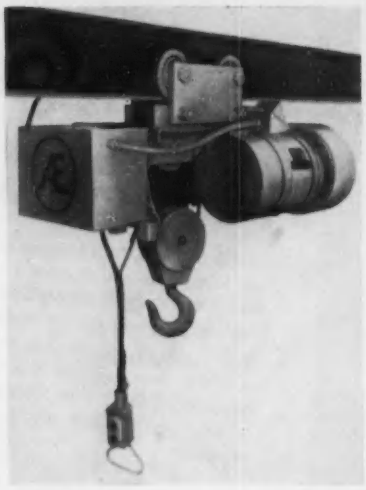
Tel-E-Lect Products, Inc—enables operator in cab to erect or store boom

Portable Water Fountain

Mink-Dayton, Inc—holds 4 gal of cool drinking water, insulated

Glass-Sheathed Cable

Non-metallic sheathed cable comes in sizes 14/2 through 4/3. Silver Triex has outer covering of Glazon braid, based on a continuous-filament glass yarn. Advantages claimed are small diameter, toughness, flexibility, easy stripping, cleaner, smoother, nonflaking, and lighter. Black printing shows up well on silver background.
Triangle Conduit & Cable Co, Inc, Triangle & Jersey Ave, New Brunswick, N. J.



Electric Hoists

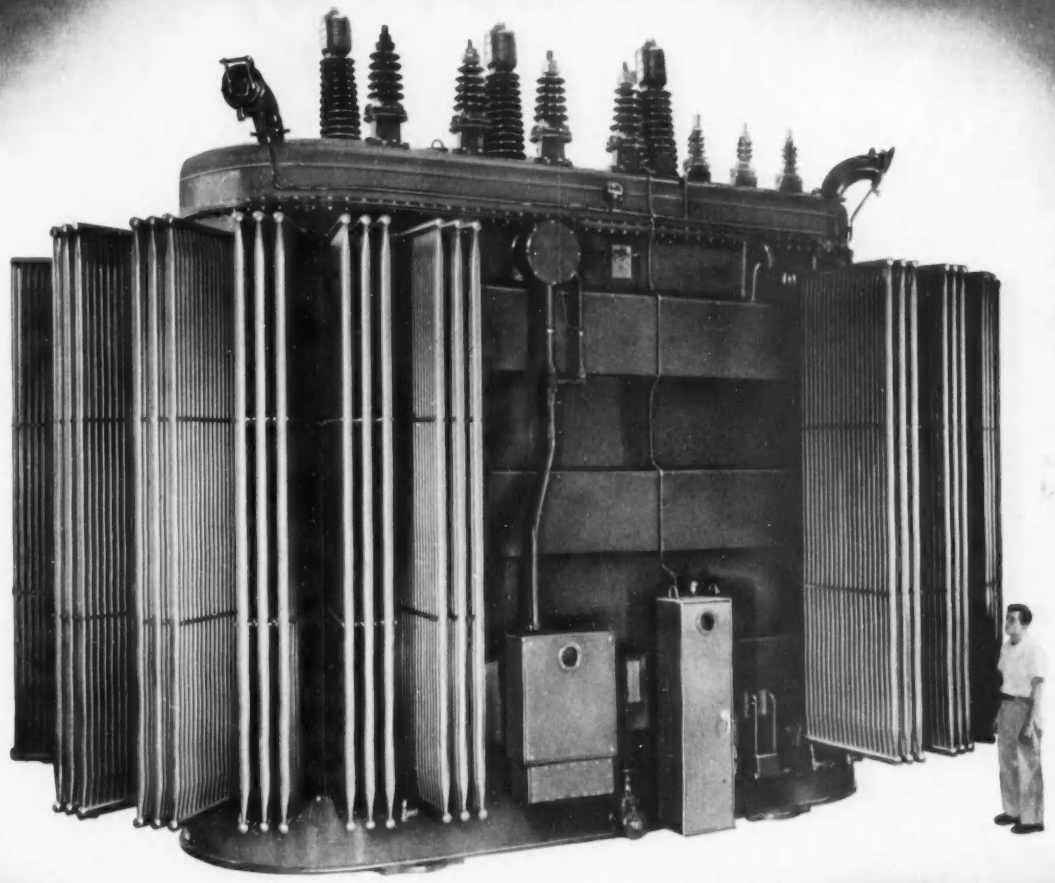
Electric hoists have 2- or 3-ton capacity. Class BB hoists have lightweight welded-steel chassis. Features include 3-reduction spur gears, automatic Weston brake, heavy-duty crane-type motor, single speed pushbutton control with 110 v at the pushbutton, completely shrouded safety-type bottom block, ball-bearing sheaves, and hook carried on anti-friction thrust bearing.
American Engineering Co, Aramingo Ave & Cumberland St, Philadelphia 25, Pa.

Parallel-Groove Clamp

Aluminum general-purpose (AGP) clamp has heat-treated body. Fortified cadmium coating resists corrosion in the connection, allowing use of copper or aluminum conductors in any combination. Resiliency of clamp keeps connection tight under all load and temperature conditions. All strands of conductor are contacted. Parallel-groove clamps are made in five sizes for main wires 6 AWG to 556 Mcm and jumper wires 6 to 4/0.
A. B. Chance Co, 210 N. Allen St, Centralia, Mo.

Time Recorder

Instrument records operating time of any electrically operated equipment. The Time-Recorder-Totalizer shows total operating time on counter-type dial. A permanent record on continuous tape shows chronologically when



60,000 kva *THREE PHASE*
Pennsylvania Auto Transformer

This Pennsylvania auto transformer will transmit voltage from a 110,000-volt system to a 45,000-volt system and also supply station service power at 13,200 volts. The transformer is rated at 60,000 Kva, with provisions for future fans to increase the rating to 75,000 Kva.

PENNSYLVANIA TRANSFORMER COMPANY

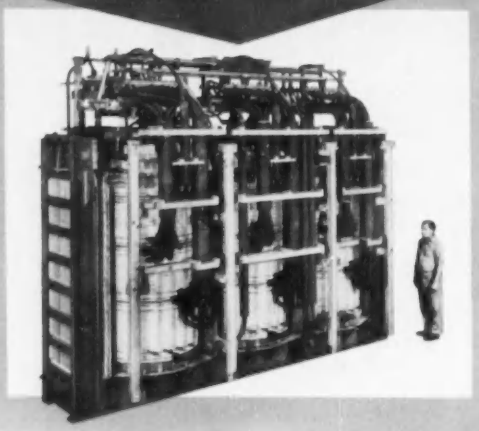
A McGraw Electric Company Division

CANONSBURG, PA. • Greater Pittsburgh District

SEE NEXT PAGE FOR INSIDE STORY

Inside a 60,000 kva THREE PHASE Pennsylvania Auto Transformer

60,000 Kva, Self-cooled. Three phase, 60 Cycles, 55°C. Temperature rise. High Voltage: 110,000Y/63,510 volts. Low Voltage: 45,000Y/25,980 volts. Tertiary Voltage: 13,200 Delta volts.



HIGH VOLTAGE SIDE OF TRANSFORMER →
Two sets of taps per coil assure excellent electrical and mechanical balance in the windings. Leads are connected to straight line tap changers through heavy pressboard tubes. Tap changers are mounted above core and coil unit where they are accessible through manholes in the tank cover.

Line ends of coils are heavily insulated to provide extra protection against surge voltage stresses.

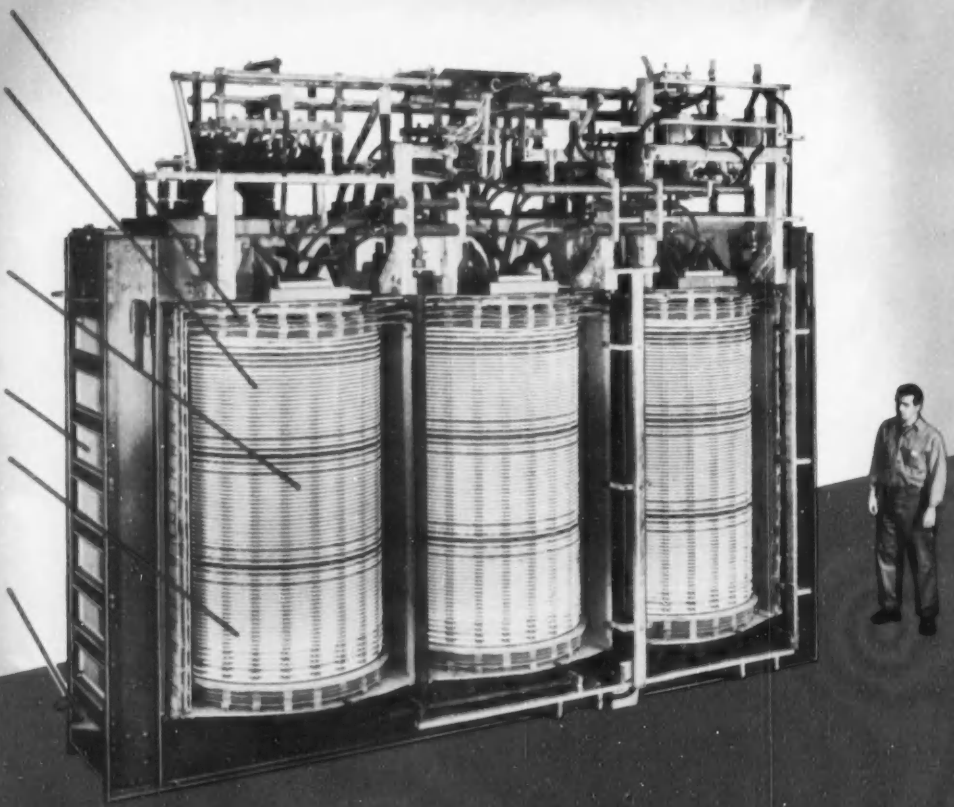
Coils are precompressed with a force equal to the highest short circuit stress and built into transformer at the compressed dimension. This prevents mechanical distortion of the coils if short circuit stresses occur.

Circular coils electrically balanced both radially and axially against short circuit stresses.

Five-legged core reduces height of transformer.

Continuous pancake windings in High Voltage coils. Helical windings in Low Voltage coils.

Guide plates fix the position of the core and coil assembly in the tank.

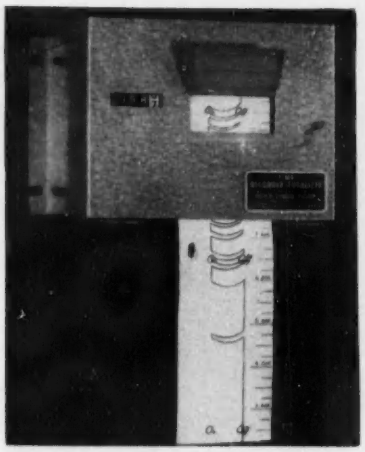


PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PA. • Greater Pittsburgh District

FOR EXTERIOR VIEW OF THIS TRANSFORMER, SEE OTHER SIDE.



equipment is on or off. One roll of tape reportedly lasts almost a year. **Heat-Timer Corp, 657 Broadway, New York 12, N. Y.**

MORE NEW PRODUCTS
about which you should know

Le Conte Plastics Co, Inc, Farmingdale, L. I., N. Y., has loop-type **cable clamps** with fiber glass base . . . Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa., has thermostat-controlled **melting pots** for 150, 750, and 1,500 lb of solder.

Brown-Brockmeyer Co, 1000 S. Smithville Rd, Dayton 1, Ohio, has variable-speed **motor control** for 1/15-3 hp . . . General Electric Co, 1 River Rd, Schenectady 5, N. Y., has portable hand **tachometers** for 2-100,000 rpm and 2-10,000 fpm.

Tect, Inc, Cortlandt and Erie St, Dumont, N. J., has Vythene low-toxicity non-inflammable **solvent** . . . W. S. Shamban & Co, 11617 W. Jefferson Blvd, Culver City, Calif., has **Teflon tape.**

U. S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif., has Type SE explosion-proof and Type SD totally-enclosed **150-hp motor** . . . Minneapolis-Honeywell Regulator Co, Freeport, Ill., has sealed heavy-duty **limit switch,** Type 51MLI.

Phaostron Co, 151 Pasadena Ave, South Pasadena, Calif., has 6-in. **panel meters** . . . Miskella Infra-Red Co, East 73rd and Grand Ave, Cleveland 4, Ohio has **reflector units** for 500 and 1,000-w infra-red lamps.

Westinghouse Electric Corp, 401 Liberty Ave, Pittsburgh 30, Pa., has **gearmotor drive** for cotton card machines . . . General Electric Co, 1 River Rd, Schenectady 5, N. Y., has Type KH dripproof, split-phase **sump-pump motor,** rated 1/3 hp, 115/230 v

Multi-Matic Corp, 14741 Bessemer St, Van Nuys, Calif. has 109-lb, 1.7-kw, 115-v dc **portable generator** . . . Universal Motor Co, 524 Universal Drive, Oshkosh, Wis. has **1.7 hp plant** giving 600 w, 110 v, 60 cps; 100 w for charging 6-v batteries; or will pump 25 gpm of water and supply 300 w ac simultaneously.

Hexacon Electric Co. 206 W. Clay Ave, Roselle Park, N. J. has 30-w, 110- or 220-v, 3-oz **soldering iron** . . . Television Accessories Co, Box 6001, Arlington 6, Va. distributes Oryx (British) sub-miniature **soldering irons.**

Coffing Hoist Co, Danville, Ill. has locking-latch **safety hook** . . . Federal Sign and Signal Corp, 8700 S. State St, Chicago 19, Ill. has flashing, industrial **warning light.**

Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa. has 10- and 20-point **strip-chart recorders** . . . R. A. Koeneman Co, 1408 Delmar Blvd, St. Louis 3, Mo. distributes midget megohmeter (German) rated 50 megohm, 500-v dc.

Hitemp Wires Inc, 36 Windsor Ave, Mineola, L. I., N. Y. has Fiberglas, Teflon-impregnated **lacing cord,** yarn, thread, and tape . . . Industrial Instruments, Inc, 89 Commerce Rd, Cedar Grove, N. J. has 12-point **rotary switch** for test equipment.

Industrial Electrical Works, 1509 Chicago St, Omaha, Nebr. has explosion-proof spring-return power **cable reel** . . . W. C. Dillon & Co, Inc, 14620 Keswick St, Van Nuys, Calif. has Model L **testing machines** with 75-in. daylight opening, ratings up to 10,000 lb.

CATALOGS AND BULLETINS

● **POWER FUSE:** Catalog Section 250, 12 pages, covers Type HSO power fuses. This boric-acid drop-out type fuse of medium interrupting capacity is rated up to 34,500 v. S&C Electric Co, 4435 Ravenswood Ave, Chicago 40, Ill.

● **BACKFILLER:** Bulletin S-118, 6 pages, covers Model 190 backfiller. Cleveland Trencher Co, 20100 St. Clair Ave, Cleveland 17, Ohio

● **HOISTS:** Bulletin SP, 8 pages, describes roller and coil-chain ratchet-lever hoists, ¾ to 15 ton. Coffing Hoist Co, 800 Walter St, Danville, Ill.

● **GE BULLETINS:** Following are available from General Electric Co, 1 River Rd, Schenectady 5, N. Y.:

GEA-5258A Adjustable-Speed Warper Drives—4 pages

GEA-5993 New Adjustable-Frequency Drive Systems for synthetic fiber machinery—8 pages

GEA-5984 Electrical Modernization of the Cement Industry—16 pages

GED-2100 New Recording Controller

GEA-5672B How to put sound (hum) rating to work in your fluorescent installations—4 pages

● **WESTINGHOUSE BULLETINS:** Following are available from Westinghouse Electric Corp, P. O. 2099, Pittsburgh 30, Pa.:

B-6098 Panelboard Planning to meet today's and provide tomorrow's electrical requirements—16 pages

B-6133 Compete or Collapse—Electric Modernization—16 pages

B-6151 Cornerstone or Tombstone—modern electrical distribution—24 pages

B-5918 Type MSP self-shielded current-limiting reactors to limit short-circuit current—4 pages

B-6054 More Profit from Rural Lines with Voltage Regulators—20 pages

● **ALUMINUM CHEMICALS:** Brochure, 4 pages, covers alumina trihydrate, activated alumina, calcined alumina, etc. Reynolds Chemicals, 2500 S. Third St, Louisville 1, Ky.

● **HERBICIDE:** Folder gives formulas for mixing brush killer. Thompson Chemicals Corp., 3028 Locust St, St. Louis 3, Mo.

● **IONIC AIR CLEANERS:** Brochure, 8 pages, covers electronic air cleaners, 800-2,400 cfm, 90% efficient, for 4-12 room homes. Electro-Air Cleaner Co, 1285 Reedsdale St, Pittsburgh 33, Pa.

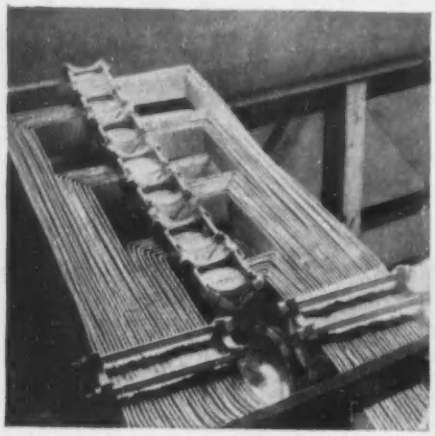
● **SWITCHGEAR:** Bulletin 200, 36 pages, covers low-voltage switchgear. Continental Electric Equipment Co, Box 1055, Cincinnati 1, Ohio

● **DOORS:** Bulletin 79, 32 pages, covers upward-acting types of doors. Kinnear Manufacturing Co, 820 Fields Ave, Columbus 16, Ohio

● **LAMINATE:** Bulletin, 4 pages, covers use of glass-silicone laminate in sealed dry-type transformers. Formica Co, 4614 Spring Grove Ave, Cincinnati 32, Ohio

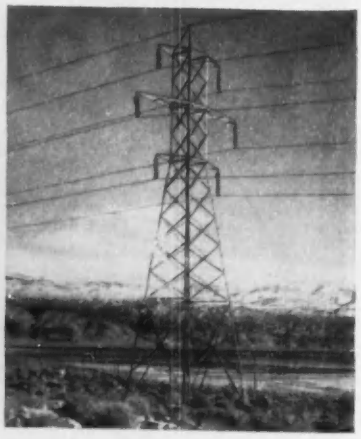
(*Continued on page* 142)

1898



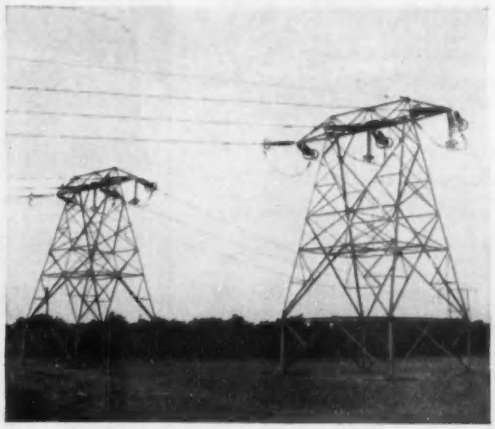
1899

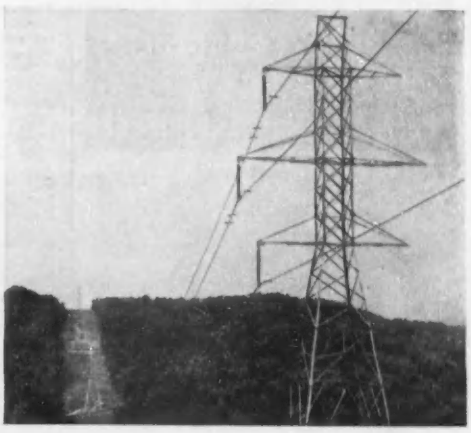
1913



Let's look at the record !

1915 **1923** **1953**





1898—First installation of aluminum bus bar. An *Alcoa* first!

1899—First aluminum transmission line. An *Alcoa* first!

1913—First ACSR line in 100-kv range. An *Alcoa* first!

1915—First aluminum distribution line using weatherproof conductor. An *Alcoa* first!

1923—First ACSR line in 220-kv range operated at 150-kv, 1913-1923. An *Alcoa* first!

1953—First Expanded ACSR transmission line. An *Alcoa* first!

Alcoa has contributed the major developments in aluminum electrical conductor products for the electric light and power industry. We believe this should be an important consideration when you buy aluminum conductor and accessories. Why? Let's take Alcoa's latest, and still exclusive, development—Expanded ACSR—as an example.

Alcoa foresaw the demand for a super-voltage conductor over 20 years ago. Laboratory research into the many electrical and mechanical problems, and studies of production followed. All this and more was behind the several million pounds of Expanded ACSR we delivered last year.

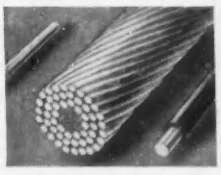
Someday you'll probably be offered a similar product by someone else at a lower price.

Those savings cannot substitute for the quality that only Alcoa can offer. You get just what you pay for.

ALUMINUM COMPANY OF AMERICA
2100-S Alcoa Building • Pittsburgh 19, Pa.

ALCOA ALCOA **ALUMINUM**

ALUMINUM COMPANY OF AMERICA



ACSR and All-aluminum Wire and Cable

Covered Wire and Service Drop

Accessories for All Conductor

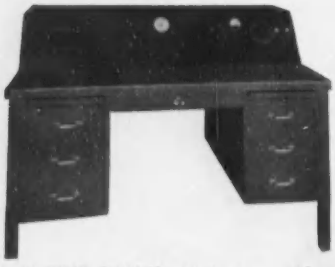
PROVEN DEPENDABILITY with STATES Relay Testing Equipment

PHASE Shifter Type R

Made in 50 to 2500 volt ampere capacities. Provides means for shifting phase continuously for every possible angular displacement. May be obtained as combination of phase shifter and induction regulator.

Resistance Type Relay Load Kit—
Capacity: 50 amperes, 120 volts

A Relay Load Kit with inbuilt cycle counter. Mounted on the panel are: Smooth current controls from .05 amperes to the full capacity of the load, cycle counter, circuit breaker type main switch, binding posts and receptacles.



RELAY TEST TABLES—Made in a wide variety of styles to fit the individual utilities requirements.

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Please send ☐ Cat. I, Sec. 2 for Phase Shifters
☐ Cat. I, Sec. 5 for Resistance Loads
☐ Cat. I, Sec. 3 for Relay Test Tables
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Firm .....
City ..... Zone .... State .....

● **RADIANT HEAT:** The Textile Report, 9 pages, covers use of radiant heat in drying and curing synthetic textile finishes. Relevant catalog sheets are also included. Edwin L. Wiegand Co 7500 Thomas Blvd, Pittsburg 8, Pa.

● **CONVULUTED COUPLINGS:** Expansion joints for low pressure and vacuum service, sizes ½-72 in., are covered in Catalog 55, 16 pages. Solar Aircraft Co, 2200 Pacific Highway, San Diego 12, Calif.

● **PANEL METERS:** Catalog N1, 8 pages, covers panel-type instruments. Burlington Instrument Co, Burlington, Iowa

● **WIRING PROMOTION:** Wiring is at Fault—But the Appliance Gets the Blame, 24-page booklet, promotes adequate wiring in cartoon form. At cost, 3½¢. National Electric Products Corp. Bldg 2, Gateway Center, Pittsburgh 22, Pa.

● **BANKED TRANSFORMERS:** Bulletin 61B8054, 4 pages, covers distribution transformers for banked secondary systems, Type ACPB, 10-37½ kva, 2,400-14,400 to 240/120 v. Allis-Chalmers Manufacturing Co, 932 S. 70th St, Milwaukee 1, Wis.

● **TRANSFORMERS:** Publication 51103, 12 pages, covers power transformers, 2,000-45,000 kva. Brush Electrical Engineering Co, Ltd, Loughborough, England.

● **WORK PLATFORMS:** Steel portable and stationary platforms are covered in 6-page folder. Ballymore Co, Wayne, Pa.

● **TEMPERING:** Catalog TD2-625, 20 pages, covers electric furnaces for tempering, 800-1650F, 220-440 v, 12-100 kw. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

● **GEIGER COUNTER:** Bulletin sheet covers Model 952 windowless flow counter for alpha or beta particles from solid samples. Atomic Instrument Co, Cambridge 39, Mass.

● **CONVEYOR:** Bulletin R-20, 4 pages, covers a tubular conveyor for bulk material; 3, 4, and 6 in sq; 30 fpm; 1.3, 2.3, and 5.5 cu ft per min. Prab Conveyors, Inc, 19815 E. Nine Mile Rd, St. Clair Shores, Mich.

● **COATING:** Leaflet, 4 pages, covers hot-melt plastic coating for protection of tools, gears, etc during storage or shipping. Fidelity Chemical Products Corp, 470 Frelinghuysen Ave, Newark, N. J.

● **LEVEL CONTROL:** Bulletin PF 544B, 8 pages, covers type 13DJ3 liquid-level control for conductive liquids. Photoswitch, Inc, 77 Broadway, Cambridge 42, Mass.

● **MOTORS:** Explosion-proof and dust-proof motors, ¾-20 hp, 2 or 3 phase, under 600 v, are covered in 4-page bulletin, ED-EX-1. Lima Electric Motor Co., 39 Findlay Rd, Lima, Ohio.

● **INSTRUMENT TRANSFORMERS:** Catalog 131-000, 30 pages, covers potential and current transformers, indoor and outdoor. R. E. Uptegraff Manufacturing Co, Scottdale, Pa.

● **CABLE TERMINATIONS:** Bulletin AD54, 1 page, covers outdoor porcelain-insulated cable end seals for Neoprene 15,000-v, 500 MCM max cables. Bulletin CJ7, 10 pages, covers cable terminations for No. 8 to 1,000 MCM, 600-15,000-v cable. G & W Electric Specialty Co, 7780 Dante Ave, Chicago 19, Ill.

● **LIFT TRUCK:** Bulletin 1360, 8 pages, covers Traveloader 5 and 15 ton side-loading lift trucks. Baker-Raulang Co, 1250 W. 80 St, Cleveland 2, Ohio.

● **PORTABLE LIGHTS:** Bulletin B52, 12 pages, covers String-a-lite portable industrial cords and lights. Joy Manufacturing Co. Henry W. Oliver Bldg, Pittsburgh 22, Pa.

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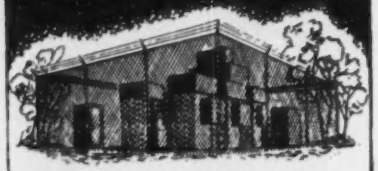

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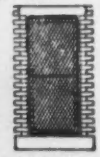
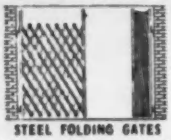
WIRE MESH PARTITIONS



WINDOW GUARDS



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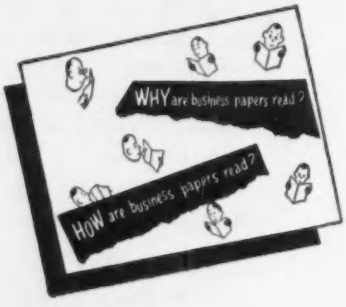

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TECHNICAL LITERATURE

SELENIUM RECTIFIERS—Bulletin 177, 24 pages, covers selenium rectifiers. Radio Receptor Co, 251 W. 19th St, New York 11, N. Y.

STANDBY POWER—Bulletin T-011, 16 pages, describes standby generating plants and line transfer controls for consumers. D. W. Onan & Sons Inc, University Ave SE at 25th, Minneapolis 14, Minn.

ASA STANDARDS—Following are available from American Standards Assn, 70 E. 45th St, New York 17, N. Y.:

Z53.1—1953 American Standard Color Code for Marking Physical Hazards and Identification of Certain Equipment. Price 50¢.

Y10.11—1953 American Standard Letter Symbols for Acoustics. Price $1.00.

B16.12—1953 Cast-Iron Screwed Drainage Fittings. Price $1.00

CEE 10 Specification for Electric Motor-Operated Appliances. (By International Commission on Rules for Approval of Electrical Equipment.) Price $2.00

Standards in a Changing World, proceedings of 4th National Standardization Conference, New York, Oct. 19-21, 1953—80 pages. Price $3.00

AIEE STANDARDS—Following are available from American Institute of Electrical Engineers, 33 W. 39th St, New York 18, N. Y.:

1 General Principles Upon Which Temperature Limits are Based in the Rating of Electric Machines and Apparatus—21 pages. Price 80¢

1C Test Code for Evaluation of Systems of Insulating Materials for Random-Wound Electric Machinery—12 pages. No charge

4 (ASA C68.1—1953) Measurement of Test Voltage in Dielectric Tests—26 pages. Price 80¢

ASA C57.13—1953 Requirements for Instrument Transformers—23 pages. Price $1.00

ASA C57.33—1953 Guide for Loading and Operation of Instrument Transformers—4 pages. Price 35¢

SLIDE RULE—Cardboard slide rule has usual scales and also natural trig functions and 4-place log table. Mechanical Industries Production Co, 217-233 Ash St, Akron 2, Ohio

INSULATING VARNISHES—Insulating Varnishes, Technical Properties and Methods of Application, 36 pages. Minnesota Mining & Manufacturing Co, 6 Argyle Terrace, Irvington 11, N. J.

LIGHTING—Lighting of shopping centers, modern stores, and supermarkets is covered in 80-page handbook. Holophane Co, Inc, 342 Madison Ave, New York 17, N. Y.

SILASTIC—A 4-page bulletin, No. 9-334, covers index to Silastic stocks and typical properties of fabricated parts. Dow Corning Corp, Midland, Mich.

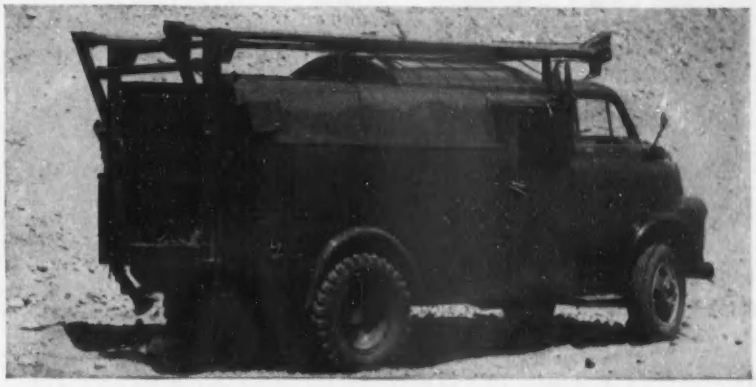
TROLLEY-BUS EQUIPMENT—Publication 337, 92 pages, covers trolley-bus and tramway overhead equipment. British Insulated Callender's Cables, Ltd, Room 1832, 11 W. 42nd St, New York, N. Y.

TROLLEY BUSWAY—Bulletin 40, 38 pages, covers electrified-track system for power distribution. Feedrail Corp, 125 Barclay St, New York 7, N. Y.

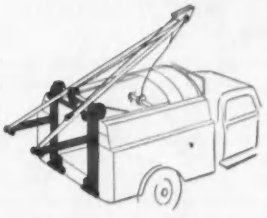
TEACHING KITS—Bulletin, 4 pages, covers experiment kits for teaching electricity. Universal Scientific Co, Inc, 1102 Shelby St, Vincennes, Ind.

LEAD PAINT—Pamphlet of 20 pages covers corrosion control of electrical structures and equipment. Subox, Inc, Hackensack, N. J.

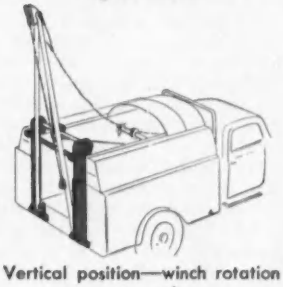
Fold Up Your Derrick from Inside The Cab!



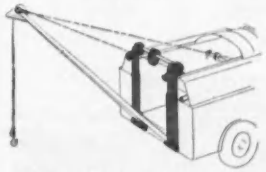
with the *Tel-E-Lect* STORAGE KIT



Derrick raised by simply engaging the winch.



Vertical position—winch rotation reversed.



Derrick is locked in operating position.

★ Saves Space
★ Saves Time
★ Saves Money

You know what a tough job it is to assemble an "A" frame derrick—and to put it away after use. Now Tel-E-Lect has a simple solution with a real dollar saving in time on the job—a saving of space on your trucks—and a saving in many hours of back-breaking and hazardous work for your men.

The patented Storage Kit fits any standard utility truck body and "A" frame derrick and it can be quickly bolted on the back of your truck by your local mechanic. The derrick will go up or down in a minute or less, entirely controlled by the man in the truck cab. Working with a double drum winch, you get live boom operation—or easily adjustable derrick elevation with a single drum winch.

The cost is only a fraction of other, more intricate derrick storing systems—and there's no rebuilding of your present equipment!

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METER
TESTING
ACCESSORIES
Now in use
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G-50
METER TEST
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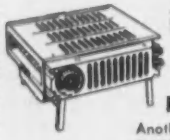
This equipment is extremely small and compact. Designed for the testing of socket type meters of 5, 15 and 50 ampere capacity, 2 and 3 wire single phase.



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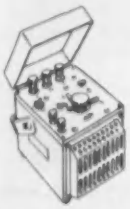
Another resistance load in a series which we believe to be radically different in design and construction from any devices heretofore manufactured for this purpose.

TYPE GA
METER TEST KIT

Designed to reduce the weight of portable equipment to the lowest possible limit. Total weight, less rotating standard and leads is 12½ pounds. 18" long, 7¾" wide and 10½" high.



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This was designed for general purpose testing of all meters up to 50 ampere capacity. Like all other loads of our manufacture, the H-50 load is rated for continuous duty. Weight 12 lbs. net.

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BOOKS

Received Since May 4

Lubrication of Industrial and Marine Machinery —2nd Edition. By William Gordon Forbes, revised by C. L. Pope and W. T. Everitt. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. 351 pages. Price $6.50.

Essays in Science. By Albert Einstein. Published by Philosophical Library, 15 East 40th St, New York, N. Y. 114 pages. Price $2.75.

Basic Electrical Engineering

Elements of Electrical Engineering—6th edition. By Arthur L. Cook and Clifford C. Carr. Published by John Wiley & Sons, Inc, New York 16, 682 pages, illustrated. Price $6.75.

This edition is rearranged, large portions rewritten, and new problems added. Emphasis is on basic principles. Dc and ac machinery and ac circuits are well covered. Electron tubes are included in relation to rectification and control circuits.

Originally published in 1924, the book is intended for non-electrical engineering students who have a knowledge of calculus.

Lightning

Lightning Protection for Electric Systems. By Edward Beck. Published by McGraw-Hill Book Co. 312 pages, illustrated. Price $6.50.

Authored by a recognized expert on arresters and lighting protection, the book is non-mathematical and expository discussion of the principles and practices of the art of system protection against lightning. Lightning phenomena and magnitudes are established and next the mechanism of arrester discharge and the subsequent cut-off of follow current. Here and in the discussion of transmission, distribution and system apparatus the treatment is broad enough to show the way for ships, oil tanks, industrial systems, etc. Selection of appropriate types and their proper location on these facilities and the duty imposed on them by surges and overvoltages closes the book except for the criteria for good grounds and a brief discussion of travelling waves.

New Approach to Microwave Antennas

Dielectric Aerials. By D. G. Kiely. Published by John Wiley & Sons, 440 Fourth Avenue, New York 16. 138 pages, illustrated. Price $2.00.

Radiators for microwave radio can be formed of dielectric material instead of conductors. Typical forms are (1) a solid rod, (2) a hollow tube, (3) a horn. All may be excited by an open-ended waveguide, poles, or dipoles to produce a single directional lobe.

A complete operating theory has not yet been established, but the author attempts to correlate mathematical analysis with experimental observations. In one concise pocket-sized monograph he presents a thorough review of developments and design data.

Primarily written for physicists and engineers not specialized in aerial design, it still provides information to aid the specialist. Utility engineers concerned with microwave equipment should benefit by knowledge of this technique.

Hydroelectrics

Electrical Design of Hydro Plants. Published by Tennessee Valley Authority, Knoxville. 449 pages, illustrated. Price $2.25

This book is Volume II of Technical Report No. 24 in the "Design of TVA Projects" series. Probably nowhere else can one find assembled the design philosophies and details of 20 hydro plants of varied siting and functioning. Starting with Norris and ending with Fort Patrick Henry the common factors are cited and then the reasoning that lead to progressive departures. Taken up separately are the generating stations, the generators, the switching and connections, the power transformers, auxiliary power and lighting, the control, the boards and the communication. An extensive appendix has the specifications for generators, transformers and breakers along with comprehensive tabulations of their details.

Electricity Training Manual

Experimental Electricity for the Beginner. By Leonard R. Crow. Published by Scientific Book Publishing Co, Vincennes, Ind. 240 pages, 8½ x 11, paper covers, illustrated. Price $2.50

This book contains a related, progressive series of 192 experiments covering important principles of electricity and practical applications. Subject is discussed in simple language without mathematics, and illustrated with detailed photographs and sketches.

Experiments cover permanent magnetism; circuits; controls; electromagnetism; induction and transformers; dc and ac motors; and apparatus such as bells, buzzers, relays, and thermostats. The author has developed a kit for $47.50 (includes this manual) which permits construction of all experiments described. Written for the beginner, general science, or industrial arts student, this manual is useful to the engineer who must explain electricity to young people.

Breakers for Banking

(*Continued from page 75*)

predetermined value of current, opening the contacts. At the instant of current interruption, under fault conditions, line voltage exists across the open contacts. The voltage coil is connected across the contacts, and upon being energized acts to hold the contacts open.

When the faulted transformer's fuse has blown, the voltage coil remains energized, even after the secondary fault has been cleared, because a circuit is completed through customer's connected load, meter potential coils, and the faulted transformer secondary winding. This feature prevents the adjacent transformers from picking up the load of the faulted transformer. When the faulted transformer is re-fused, the voltage across the open contacts drops to zero, de-energizing the voltage coil and allowing the contacts to reclose by gravity action of the circuit breaker plunger.

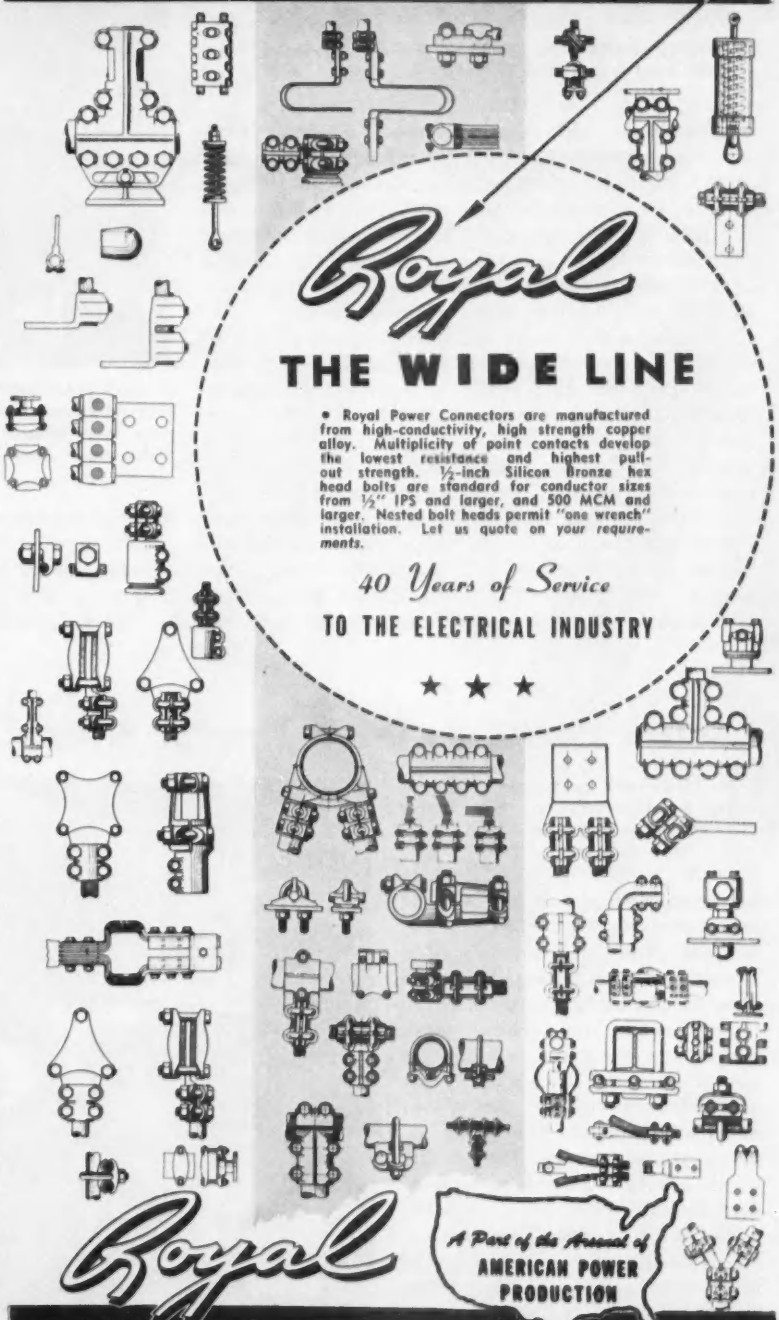
Operating Experience . . . San Antonio has been operating overhead secondary networks since the middle thirties using fuses at the junction points. At first 30- and 40-amp fuses were used, but because of excessive loss of fuses the size was increased. At present 75-amp links are used. With this size link it has been found that approximately 25% of the fuses are blown each year. There are 1,395 networks now operating averaging from 6 to 7 transformers per secondary network.

When the trial installation of these new breakers was made, operation counters were installed on 20 of the units which were placed in particularly troublesome locations. These were checked periodically over a period of several months, and numerous operations were observed. The original units were rated at 35/70 amp pickup, with the current coils arranged for either series or multiple connection.

The initial installation was made with the 35-amp connection. They were subsequently changed to 70 amp, and the number of operations was greatly reduced.

These breakers may be applied to either loop or grid type networks. They will operate equally well on either type.

when you need . . . .
POWER CONNECTORS • GROUND CLAMPS AND EQUIPMENT TERMINALS *be sure to check*



Royal
THE WIDE LINE

• Royal Power Connectors are manufactured from high-conductivity, high strength copper alloy. Multiplicity of point contacts develop the lowest resistance and highest pull-out strength. ½-inch Silicon Bronze hex head bolts are standard for conductor sizes from ½" IPS and larger, and 500 MCM and larger. Nested bolt heads permit "one wrench" installation. Let us quote on *your requirements.*

40 Years of Service
TO THE ELECTRICAL INDUSTRY

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Designers and Manufacturers of Power Switching Equipment and Special Electrical Devices

INDUSTRIAL APPLICATIONS

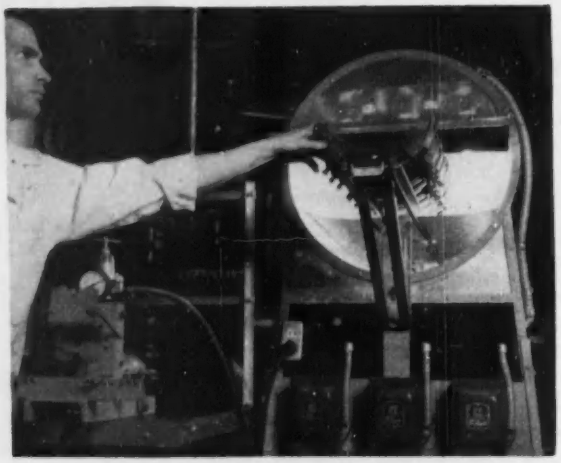
Larger Electric Oven Ups Capacity 400%

WAYNE F. MULCOCK, Consultant, Business Development Dept, Utah Power & Light Co, Salt Lake City

Capacity to produce relined automobile brake shoes has been increased by 400% at the Mendenhall Auto Parts Co, Salt Lake City, with the installation of an 11-kw infra-red oven. With the same work force as before, the company now can turn out 250 shoes per hr compared with the 50 per hr permitted by the two 3-kw electric ovens formerly used. The infra-red installation also effects a perfect bond between linings and metal shoes.

To effect a good bond, the lining and shoes must be heated to a certain temperature for a certain period. Previously the shoes were placed in a spring-loaded clamp to secure the lining and then stacked 20 at a time in the ovens. Baking time was 45 to 60 min. This method was unsatisfactory because oven temperature was not always uniform and linings did not always bond securely.

The new infra-red oven consists of 22 R-40 lamps rated 550 w each. They are mounted in a cylinder over a continuous conveyor. Shoes and linings pass through the oven in 15 min. A perfect bond is effected because heat is directed to the metal shoe and penetrates to the bonding compound between linings and shoes.



BONDED BRAKE SHOES may be turned out at 250 per hr through use of an 11-kw infra-red oven. A perfect bond results every time. Air press under worker's arm compresses shoe and lining into spring-loaded holder before they are placed on continuous conveyor

Cost of energy per shoe by the former method was 2.8 mills. At the same cost per kwhr, cost per shoe now is only 1.1 mills at full production. This, cost of energy is only an incidental expense.

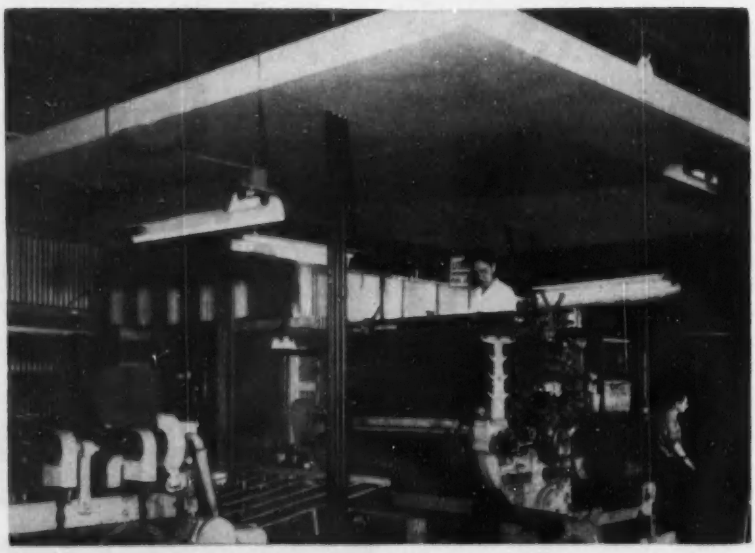
Radiant Heat Cuts Down Time of Press

J. M. JENNINGS, JR. Industrial Engineering & Utilization Dept, New Orleans Public Service, Inc, New Orleans, La.

Space heating of lithographing press area with electric radiant heat rubber paneling at New Orleans plant of Continental Can Company's Bond Crown and Cork Division has overcome an unusual heating problem.

The metal lithographing press, housed in a metal-clad building, got so cold during the 30-40-F nights that occurred this past winter that several hours of down time were being experienced each morning. This was due to the greatly increased viscosity of the ink on the rollers when very cold.

The rubber radiant heat paneling was installed in a 12 by 16-ft area over the press at a height of 11 ft above the floor. Since the girders which were to support the panels were 16 ft above the floor, a height considered too high for most efficient use of this heat source, a frame of 2-in. by 6-in. lumber was constructed to which the individual 4 by 4-ft panels were screwed. The completed 12 by 16-ft frame was hung from the girders using turnbuckle rods. This made it possible to level the frame easily.



CEILING HEATING PANELING over metal lithographing press keeps ink at proper viscosity and provides employee comfort. Several hours down time is cut daily

A temperature of 70 F is now easily maintained, keeping the ink at the proper viscosity and helping to provide employee comfort. The installed load is 4.4 kw.

Make Guys safe with

CHANCE GUY GUARDS...

a type for every installation

SURE-GRIP® *

Made of heavy gauge steel—hot galvanized to assure high visibility and long life. Half round or full round types. 7 and 8 foot lengths. Sure-Grips will fit any size anchor rod.

The Sure-Grip features this slotted, non-removable "keeper" piece that locks the guy strand firmly and keeps the guard from sliding or turning.

MONO-BOLT® *

This heavy gauge steel, hot galvanized protector is secured to the guy strand with a flanged hook at the top of the guard. Half round or full round, in 7 and 8 foot lengths.

The Mono-Bolt Clamp, with only one nut to tighten, securely grips the anchor rod with a firm three point gripping action. Fits any size rod from ½" to 1¼".

MATTHEWS †

These half round guards save a lot of space on trucks and in storage, because they nest together. Matthews Guards are exceptionally strong—made of galvanized steel. Available in 7 and 8 foot lengths.

The patented upper clamping member is an integral part of the guard and securely locks on the guy wire. The lower end of the guard fastens to the guy clamp bolt.

Only Chance offers such a complete line of guy guards to meet your installation requirements. The line includes the service proved Sure-Grip, popular with linemen because there is nothing to take apart and re-assemble—no loose parts to lose. More than a million Sure-Grips are in use throughout the country . . . that's proof of the success of this protector.

Another favorite is the Chance Mono-Bolt, standard choice of hundreds of utilities. The Mono-Bolt combines normal guy wire protection requirements—safety, durability, and economy—with a simple installation method.

The Matthews Guy Guard cannot be turned or twisted on the guy wire. These one piece protectors are designed to cover the guy rod and wire to the ground line even if the rod barely extends above the ground.

* *Made by Specialty Devices Company, Subsidiary of A. B. Chance Co.*

† *A product of the A. B. Chance Company Matthews Plant.*

ABC INDUSTRIES

CO54-7

A·B·CHANCE CO·

CENTRALIA, MISSOURI · SAN FRANCISCO, CALIFORNIA

Infrared Cures Special Enamels

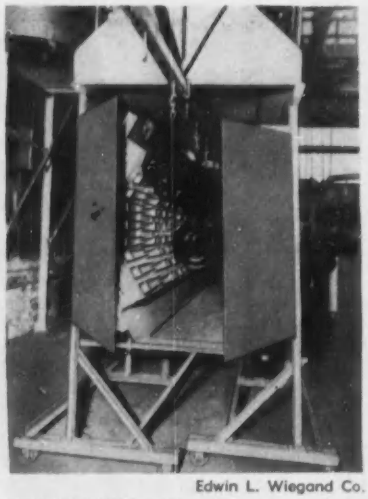
Heating special enamels on wire spoke hub caps and other miscellaneous metal parts in radiant infrared oven at A. S. Campbell Co, Inc, East Boston, Mass., obtains fast and accurately controlled curing. Hub caps are finished at rate of 200 an hour.

Problem was to obtain quick but thorough curing of Alkyd-urea-phenol-formaldehyde-melamine enamel on the wheel discs. But a baking oven was wanted that would be flexible enough to handle paint baking of other parts of different sizes; including grill and bumper guards, license plate frames, and bumperettes.

Installation of 24 electric radiant panels met all requirements. The panels, which are rated at 10.8 kw each, were easily bolted to simple steel framing to form two oven halves. These sections are mounted on casters so that oven can be adjusted for different sizes of parts and for heating requirements. Each panel is 4 ft long, giving a 16-ft oven with four heat zones.

Exact heat is measured out for each part by means of four input controllers and eight magnetic contactors. Each contactor energizes a group of three panels and input controllers modulate output of several panels from 0% to 100% capacity for close vernier control. This provides accurate heat for widely varying requirements. Temperatures can easily be duplicated day after day.

For fast curing finishes or for very light work, any section of the oven can be turned off entirely. A continuous conveyor takes parts from paint booths through the radiant oven, and on to the take-off point. Conveyor speeds can be varied from 2 to 8 ft per min. Average time in the oven is only 4 minutes for the wheel covers, while curing time for the other parts is between 1½ and 8 minutes. When parts leave oven, their temperature is about 400 F. To allow time for cooling, and to save floor space also, parts are raised to ceiling and carried overhead to unloading point.



Edwin L. Wiegand Co.

CONVEYORIZED radiant infrared oven heat-cures enamel on wire spoke hub caps in 4 min. Oven sections are caster mounted for adjustment to different size parts and heating requirements.

Flush Cabinets Hide Dry-Type Transformers

Westinghouse Electric Corp.

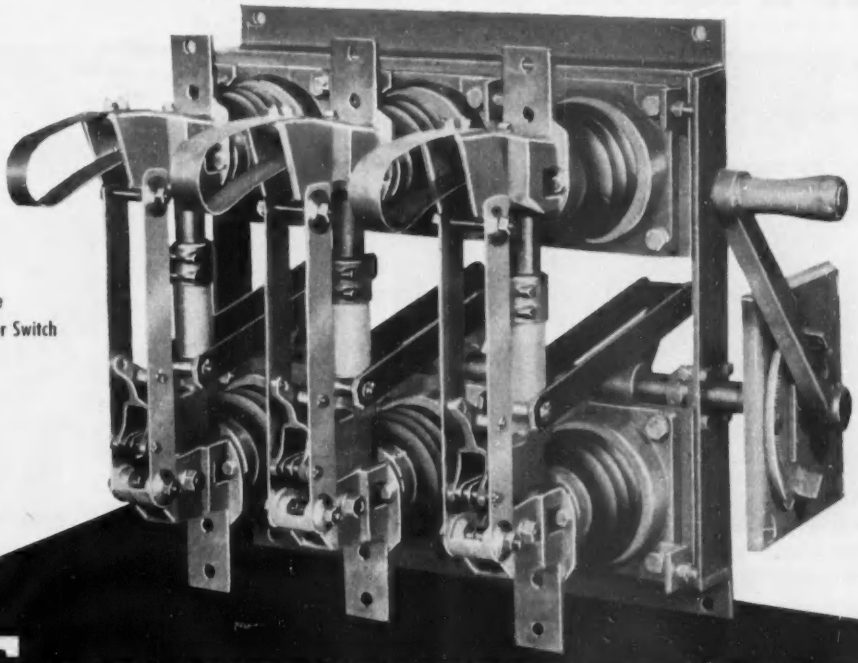
By mounting dry-type distribution transformers in flush metal wall cabinets at DuBourg High School, St. Louis, they are kept as much out of sight as possible and at the same time they function perfectly. The metal cabinets set flush into the walls much like lighting switch panels. Louvers in removable front panel allow adequate air circulation. The 15, 20, 25, and 30-kva transformers were suspended, and other precautions were taken to prevent noise amplification as much as possible.

INDUSTRIAL BRIEFS

Curing rubber in electrically heated molds at Precision Rubber Products Corp, Dayton, Ohio, provides accurate temperature control (within 3 F) and assures close tolerances for extreme precision requirements. Synthetic rubber rings, used as washers, gaskets, and seals in the hydraulic field, are completely processed electrically. The rubber compound is mixed and then rolled into a sheet of the desired thickness. Rings of the approximate rough size are stamped out and then put into precision molds that are electrically heated to give proper temperature for molding. Total load at the plant is 2700 hp. There are several 60-kv molds and some smaller ones. C. C. Day, Power Sales Engineer, Dayton Power & Light Co.

Generating steam with electric steam generator at H. Zussman Co, Cincinnati, Ohio, eliminates necessity of operating main plant boiler and permits rapid generation of steam. When pressing operation is completed, steam generation can be discontinued at once. The electrical operation is both efficient and economical and is well suited for the intermittent pressing service for which machine is used. Generator heating elements are arranged for either single or three-phase operation. Unit is fused for 90 amp at 220 v, 1-phase or 60 amp at 220 v, 3-phase. L. J. Langevin, Power Engineer, Cincinnati Gas & Electric Co.

Hardening camshafts for Ordnance Corps tank and cargo carrier engines in electric salt bath furnace at Continental Motors Corp, Muskegon, Mich., is completed in only 15 min compared with 45 to 60 min required by other types of hardening. The largest camshafts are hardened to strict metallurgical specifications in fastest possible manner in smallest possible space. Maximum production is accomplished in minimum floor space with simplified materials handling. 22-lb, 50-in. long camshafts are hardened in bath working dimensions of only 28 in. long, 11 in. wide by 58 in. deep. Occupying only 31 sq ft of floor space, furnace has heating capacity of over 200 lb of work per hour. Ajax Electric Co, Tips and Trends



3 P.S.T. 400 Ampere
5 KV. Air Interrupter Switch

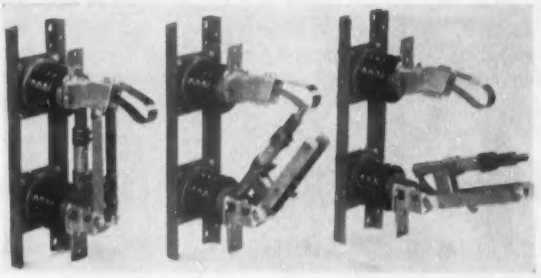
3E AIR INTERRUPTER SWITCHES

...Maximum Efficiency for 5 Basic Switching Jobs

1. **Interrupting magnetizing currents of transformers.**
2. **Interrupting charging current of lines and busses.**
3. **Interrupting exciting current of feeder regulators.**
4. **Interrupting load currents to rated capacity.**
5. **Sectionalizing feeders and distribution circuits.**

Costing less than circuit breakers, and with the interrupting capacity not found in air break disconnects, the Three E Air Interrupter Switch is ideal for these intermediate jobs. Combined with power fuses, they offer full circuit protection where automatic restoration of service is not required. The dry type interrupter unit generates gas blasts to confine and extinguish arcs. Operation is fast, clean and efficient.

Available from 5 to 15 KV. and 400 to 600 amperes.



OPERATING SEQUENCE

As the blade starts to open the upper end of the interrupter unit engages the auxiliary contact completing circuit thru interrupter. The blade then shunts *all* current thru the interrupter (center figure). The spring mechanism trips, breaking the circuit wholly within the interrupter. Closure reverses the procedure. With the Three E, making and breaking the circuit is always done *inside* the interrupter unit and never by the blades and clips.

Ask for Bulletin 142

THREE E — ELECTRICAL ENGINEERS EQUIPMENT CO.

Melrose Park, Illinois

LIVING ROOM DISPLAY at the Chicago Lamp Show was designed by C. E. Stevenson, president of the American Institute of Decorating

PORTABLE LAMP DISPLAY showed many types of lamps including those used in the living room display as well as how to place them

Light for Functional and Decorative Purposes

A living room, light-conditioned and decorated by C. Eugene Stevenson, president, American Institute of Decorators, was displayed at the recent Chicago Lamp Show. The display was co-sponsored by the Lamp and Shade Institute of America and General Electric Company's Lamp Division.

The display showed the wise and tasteful blending of lamps and lighting with the room. It showed light for functional purposes and for decorative purposes, demonstrating how light can be beautiful as well as utilitarian. Portable lamps were shown as a coordinated group.

Pictures were on display to show the effect of different types of lamps, made by different manufacturers, all good.

There was also a portable lamp display. One section of this display showed how to place lamps for close eye work to avoid glare, and to prevent squinting. Another section demonstrated the difference between poor lighting and good lighting. The former was provided by the standard inside frosted bulb with a shade having no liner and with no reflector on the lamp. The latter was provided by adding a liner to the shade and a reflector to the lamp, reducing glare and producing a good quality of indirect lighting.

Special purpose shades for the bedroom were also demonstrated. Different effects, produced by 30 watts, 70 watts and 100 watts, were shown.

Lucky Lady Promotes $1 Million Worth of Appliances

A "Lucky Lady" campaign to sell over 5,300 electric appliances worth $1 million is the second-quarter phase of Washington Water Power Co's Operation Big Switch. Working in conjunction with the Inland Empire Electrical League, the utility hopes to equal the results of the first-quarter promotion of space heaters and laundry equipment.

During that promotion, clothes dryer sales were 107% over the previous period in 1953. The entire white-goods business in Water Power's area showed a 19.3% increase in unit sales over last year, in spite of the sales declines in other lines.

In the Lucky Lady campaign, emphasis will be placed on replacement to sell 3,000 ranges system-wide. To sell 1,915 water heaters, the need for a larger heater to keep pace with increased water uses will be stressed. The combination of dishwasher and disposer as the "electric sink" will be promoted to complete the "all-electric" kitchen. Quota for dishwashers is 300; for disposers, 150.

As part of the campaign to sell dishwashers, a "Lucky Letter" contest will run for eight weeks. A new advertisement each week will provide an opportunity for contestants to determine the number of lucky letters in the ad. The correct number, plus an entry blank telling in 25 words or less why an electric dishwasher is wanted, will determine the winner each week. Entry blanks will be available only from dealers.

The dishwashers offered as prizes are being provided by distributors in Spokane. Many of these distributors do not have a dishwasher line, but they are cooperating because they are convinced this is a sound method of attracting store traffic.

To promote the Lucky Lady campaign, four ads per month will run in 48 daily and weekly papers. In addition to larger ads, small "teasers" will

be spotted in the dailies at certain stages of the campaign. On radio, over 1,000 spot announcements and 200 sales talks will be presented as the campaign progresses.

Reddy Kilowatt appliance commercials will appear on TV at the rate of ten per month. In addition, dealers will get free time on the utility's TV kitchen program to demonstrate their appliances. Outdoor promotion will be presented on 22 billboards. Posters and banners will be made available to dealers to tie-in with the campaign and contest.

Electric Feed Grinding Profits Small Farmer

WALTER L BAKER, JR
Alabama Power Co, Birmingham, Ala.

His herd of 12 Holstein cows netted H. B. Worsham about $75 a week last year. Mr. Worsham has a real milk factory on a 17-acre farm near Tuscaloosa, Ala. For seven years, he operated a sheet metal shop. He was not satisfied with life in the city, however, and a little over two years ago, he sold his business and moved to the country.

Mr. Worsham knew little about farming but felt that dairying could be run like any other business and started out keeping careful records of costs, income, production, etc. He soon found that the 17 acres in his place did not make quite enough pasture for his cows to graze. Feed costs were high and buying rations for his cows cut deeply into his profits. He figured that the problem could be solved if he could make his own feed, however, and in shopping around, he found a good buy on a 25 hp electric motor. He immediately ordered a feed mill to go with it and installed it in one corner of his barn. He needed a mixer and ordered one capable of mixing 1200 lbs of feed in one operation.

Both of these pieces of equipment were installed about a year ago. Mr. Worsham then took his cows off pasture and began using the legumes that he was producing for hay. Instead of feeding the hay directly to the cows, he ground it and mixed it with other ingredients purchased in bulk to make a 14% dairy feed. He found that this ration could be made for about $2.20 a hundred weight, giving him a saving over "bought feed" of about $2.60 a bag.

To supplement his income from dairying, Mr. Worsham decided to go in the poultry business and built a 6,000 capacity broiler house. It didn't take him long to find out that he could also make his own poultry feed by buying the ingredients in bulk, running them through his mill, and mixing them himself according to a set formula. This operation enabled him to save $1.47 per sack on poultry feed.

The combined operation is working well for this modern farmer. With his electric feed mill and mixer, he is able to prepare in a few hours after supper, enough feed to supply his herd of cows plus his broiler flock for an entire week. He has been so pleased with the addition of poultry as a supplemental source of income, that he is building another 6,000 capacity house. Electric heating cable in concrete will be used as a source of heat for the brooders in his new broiler house. An automatic poultry feeder is already on order to make his production operations almost entirely automatic.

CHOPPED UP in the feed mill, legume hay is blown into the mixer where other nutrients are added to make a complete ration. Farmer Worsham shows the operation to John Spence, Alabama Power rural service engineer. This mill prepares feed for 12 cows each averaging a milk production of 35 lbs per day, and for broilers in a 6000-chick poultry house. Another poultry house is being erected.

New Basis of Rating Power Circuit Breakers

To the Editor:

The article, "Should ASA Basis for Rating Power Circuit Breakers Be Changed?" in the May 3 issue, presents a subject which has been under study for many years. Many of us have felt that there may be a need for some changes in the present ASA method of rating breakers based on the wealth of information on breaker performance that has been obtained since the present ASA method was adopted.

Our studies have, however, led to the conclusion that the present definition of interrupting current is fundamentally sound and broad in application and should be revised rather than discarded in favor of an entirely new definition.

There appears to be a definite need to provide for demonstrating interrupting ability for both symmetrical and asymmetrical currents and to specify the rate of rise of recovery voltage. The authors apparently feel that the present ASA method should be changed because they say, "A simpler method of rating the short circuit capability of power circuit breakers is needed."

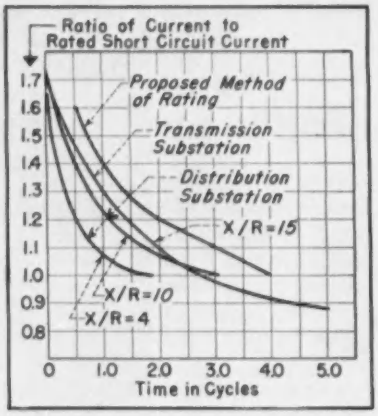
Proposed Basis More Complicated . . . As a matter of fact, the basis of rating proposed by the authors is much more complicated than the present ASA basis because the proposed method incorporates a definite system characteristic and many application factors. Thus by including in the basis of rating such things as relaying time and a fixed time current characteristic, the flexibility of the present method of rating has been sacrificed to obtain some questionable advantages in breaker application.

The article states that the application engineer needs to have available only:

1. The maximum operating voltage at the breaker location.

2. The short circuit reactance to the point of fault.

Undoubtedly the authors feel that with the exception of generator breakers the system characteristics which have been incorporated in the proposed basis of rating are so conservative that the application engineer need give no further consideration to them. That these characteristics are conservative is illustrated by the accompanying curves which show the characteristic incorporated in the proposed standard, characteristic curves for typical transmission substations and for distribution substations.



ASYMMETRICAL 3-phase fault current plotted against time in cycles

The curve which the authors have used as a basis of rating is quite typical for substations at generating plants and, therefore, is representative for only a small portion of the total number of breakers in use. As shown by the curves, breakers designed to meet the requirements of the proposed basis of rating will have 10 to 20% greater interrupting ability than can be utilized for many breaker applications. Even if we are to consider the 10 or 20% unusable ability as being of no consequence, it must be remembered that from a practical point of view breaker ratings have been standardized in definite rating steps so that the 10 or 20% larger breaker requirement may mean the use of the next larger standard breaker which would represent an appreciable increase in cost.

Many users find it advantageous to apply breakers on the basis of ground fault currents. The characteristics of ground fault currents are quite different from those of 3-phase fault currents, and the proposed basis of rating geared to a 3-phase fault characteristic does not provide the application engineer with the information required.

The authors have pointed out that the proposed method eliminates many multiplying factors. We believe that it eliminates only one factor which, in the simplified method of calculating fault currents, is a factor to convert symmetrical current to asymmetrical current at the instant of breaker contact parting. An examination of the comparison which the authors have presented of ratings between the proposed method and ASA C37.6 will show that the multiplying factors have simply been transferred from the discretion of the application engineer and incorporated in the breaker rating. The application engineer is still not relieved of the necessity of using other multiplying factors such as the derating factors for reclosing service.

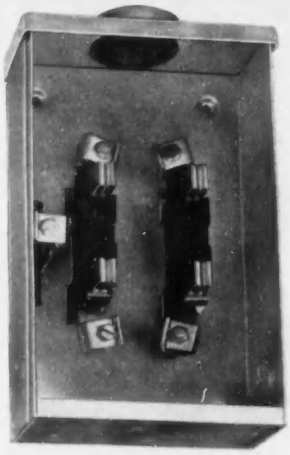
Re-examination Needed . . . We agree that there is a definite need for a re-examination of the basis of rating breakers. The approach, however, should recognize satisfactory American experiences and be based on a study of the inadequacies of the present method. Primary consideration should be given to eliminating these inadequacies. Such simplification in application as may result should be incorporated, but simplification should not be made the primary objective. The present method is perfectly general and is based on fundamental requirements.

In the light of recently published information, it appears to be essential that the ability of breakers to interrupt symmetrical as well as asymmetrical currents must be demonstrated. This can be accomplished in any one of several ways such as assigning symmetrical and asymmetrical ratings, assigning a symmetrical rating and requiring that tests also be made with asymmetrical currents, or by retaining the present method of rating and specifying that breakers must be capable of interrupting either asymmetrical or symmetrical currents and including suitable tests in the prescribed test code.

J. A. Elzi
Commonwealth Associates, Inc
Jackson, Mich.

MILBANK METER SOCKETS

Feature More Wiring Space

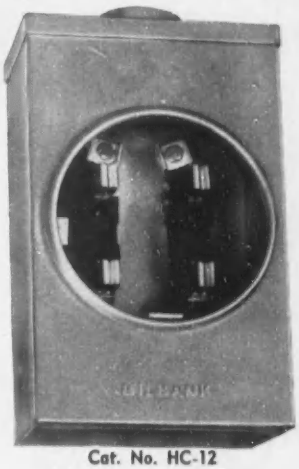


Without Cover

The HC-"12" with Lay-in Connectors

Reduces installation time to a minimum because the HC-"12" connectors are angled toward hub eliminating bending of cable. 5th terminal (not shown) is optional.

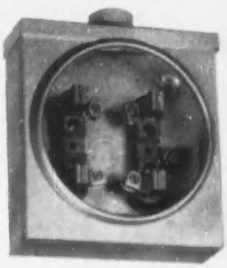
4/0 Capacity
1½" & 2" Hub
1¼" - 1½" & 2" Concentric Knockouts
Made from Galvanneal Steel or 3SH-14 Aluminum, as desired.



Cat. No. HC-12

The MIDGET SOCKET

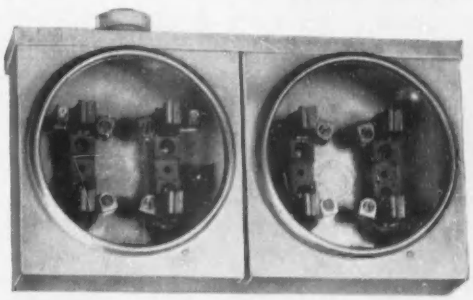
"With Lots of Wiring Room"



Cat. No. MS-1

Convenient Connectors
Wire Capacity—No. 8 to No. 1
Hub Size—1" & 1¼"
Knockouts—Concentric ¾"—1"—1¼"
Made from Galvanneal Steel or 3SH-14 Aluminum, as desired

EXCLUSIVE WITH MILBANK! The MS-2H features extra terminals for running buss to second socket.



Cat. No. MS-2H

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MILBANK MFG. CO.
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Kansas City, Mo.

You Can Bank on MILBANK

Specialists in Electrical Instrument Housings

Fite Made Head of Florida P&L

Former vice president succeeds McGregor Smith, who was elected to unfilled post of chairman of the board.

ROBERT H. FITE

Robert H. Fite, vice president and general manager of Florida Power & Light Co, has been elected president and general manager. He succeeds McGregor Smith, who was named to the unfilled post of board chairman.

The newly appointed president first joined Florida P&L in 1926 as an engineering estimator, advancing to general sales manager in 1934. He left the Florida utility in 1936 to join Ebasco Services, Inc, in New York and three years later was made head of its sales department. In 1941 he was put in charge of Ebasco's Washington office.

Upon his return to Florida P&L in 1945, Fite was appointed commercial vice president and a director. He was elected a vice president and general manager five years later.

Florida P&L's new board chairman became affiliated with the southern utility when he was named its vice president and general manager in 1939. In September of that year he was appointed president. Smith, an engineer who has had wide experience in utility operation, was president and general manager of Louisiana Power & Light Co before joining FP&L.

PUAA Elects Westin President

C. FRED WESTIN

New president of the Public Utilities Advertising Association is C. Fred Westin, assistant director of advertising for Public Service Electric & Gas Co, Newark, N. J. Westin, formerly the association's first vice president, succeeds Walter G. Heren, director of advertising and public relations for Union Electric Co of Missouri.

PUAA's other newly elected officers are: First vice president, Raymond W. Fenton, Peoples Gas Light & Coke Co, Chicago; second vice president, Robert H. Bridges, Cleveland Electric Illuminating Co; third vice president, Richard D. Furber, Northern States Power Co, Minneapolis; secretary, George G. Hanel, Connecticut Light & Power Co; and treasurer, Mead Schenck, Interstate Power Co, Dubuque, Iowa.

Newspaper Experience . . . After graduating from Williams College in 1935, Westin entered the newspaper field. He spent ten years working with weeklies as editor and publisher before becoming director of public relations and employee relations for the Army Ordnance Department at Picatinny Arsenal in New Jersey in World War II. Prior to joining Public Service E&G in 1946, he was for two years director of advertising and publicity for New Jersey Power & Light Co.

•

Henry C. Egerton, treasurer of Bull-Dog Electric Products Co, Detroit, has been elected a director of the firm.

J. E. Auchmoody has been promoted from assistant to the president to comptroller of Simplex Wire & Cable Co, Cambridge, Mass. Most of Auchmoody's business career has been devoted to financial work.

J. FRANK BLAKE, JR

Heads Maryland Group

J. Frank Blake, Jr, general manager of Conowingo Power Co, Elkton, Md., has been elected president of the Maryland Utilities Association to succeed E. Cleveland Giddings, vice president of Capital Transit Co, Washington, D. C. Other officers elected include: First vice president, George M. Nelson, president, Eastern Shore Public Service Co; second vice president, C. Oscar Berry, general counsel, Washington Gas Light Co; secretary, Robert L. Smith, district manager, Potomac Edison Co; and treasurer, Austin E. Penn, vice president, Consolidated Gas, Electric Light & Power Co.

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Need *structurals?* Here you find the most complete selection, including extra-long lengths. And, you can depend on square, practically burr-less friction saw cutting because of our special method of blade alignment and frequent blade changes.

Need *plates?* You get them here up to 10 inches thick. And shops which have had difficulty forming A-7 quality plates will be glad to know that Ryerson now carries plates of forming and welding quality.

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an unsized fibreboard having excellent dielectric, physical and chemical properties. Is used principally in air, oil and askarel transformers.

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a high grade board for electrical insulation, possessing high tensile and dielectric strength. Used in a large variety of punchings and other insulating applications.

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an extremely hard and tough board of superior quality. Used by many leading manufacturers of electrical equipment to replace more expensive types of insulating materials.

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Contact your jobber of *Crapo* Galvanized Products or write direct for further information!

INDIANA
STEEL & WIRE COMPANY
MUNCIE, INDIANA

ARTHUR T. HUNTER

FRED O. PAHMEYER

Hunter, Pahmeyer Named VP's

Arthur T. Hunter and Fred O. Pahmeyer have been elected vice presidents of Combustion Engineering, Inc, New York. Hunter joined the firm in 1941 as a member of the Philadelphia office sales staff. Since 1949 he has been at sales headquarters in New York, serving in an executive capacity. Pahmeyer has been general manager of Combustion's St. Louis Manufacturing Division since 1927. As vice president he will continue as manager of the St. Louis Division.

New B.C. Power Commission Members

A new three-man British Columbia Power Commission has been appointed to replace the commissioners who resigned after being held negligent in landslides last August which destroyed the Whatshan hydro project powerhouse. The new power commission was appointed by British Columbia's Provincial Minister, W. A. C. Bennett.

New commission members are (left to right) Dr Hector J. MacLeod, dean of applied science at the University of British Columbia; Chairman Thomas H. Crosby, former Pacific regional manager for Canadian Westinghouse; and James D. W. Blyth, who served as treasurer of the commission until last year, when he became comptroller of Brazilian Light, Power & Traction, Ltd, Toronto.

STANLEY C. KILLIAN

Elevated by Delta-Star

Stanley C. Killian, chief engineer of the Delta-Star Electric Division of H. K. Porter Co, Inc, has been appointed assistant general manager and chief engineer of the division. Killian, a graduate of the University of Michigan, was made research and development engineer by Delta-Star in 1941, advancing to chief engineer three years later. He is active in committee work of American Institute of Electrical Engineers and National Electrical Manufacturers Association. In 1952 he won the AIEE Great Lakes District Paper Award.

OBITUARY

Dana M. Wood, 70, who retired March 1 after 20 years' service with Tennessee Valley Authority, died at Wellesley, Mass., May 10. Wood's last post with TVA was chief of power studies. Before joining the authority, he was an engineer with Stone & Webster Engineering Corp in Boston for two decades.

Arthur L. Davis, 61, general superintendent of Western Massachusetts Electric Co, Springfield, Mass., until his retirement last December, died recently at Miami, Fla. Prior to his 22-year association with the New England utility, Davis, an engineer, was employed by Alabama Power and Bangor (Maine) Hydro Electric Co.

Patrick H. Tumelty, 70, for many years manager of the Peabody (Mass.) Electric Light Department prior to his retirement, died there May 5.

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• Page Chain Link Fence, pioneered by Page and made only by Page, is quality controlled from raw metal to erected fence. Whether you choose heavily-galvanized Copper Bearing Steel, or long-lasting Stainless Steel, or corrosion-resisting Aluminum, you'll have a rugged fence on sturdy metal posts deep-set in concrete. Choose any one of 8 basic styles, varied by heights, types of gates, posts, top rails and barbed wire strands for extra protection. And to be sure of reliable workmanship your fence will be expertly erected by a specially trained firm. For helpful Page data and name of member nearest you...

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Please forward my free copy of the McGraw-Hill "Industrial Direct Mail Catalogue."

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Address_____

City_____ State_____

Georgia P&L

(*Continued from page* 82)

—than manufacturing it themselves or buying it from the Florida Power Corp. The commission also entered a show cause order demanding to know why Georgia P&L should not buy power from Georgia Power—which has a cheaper rate than Florida Power. The same order told Georgia Power to show cause why they should not sell power to Georgia P&L.

It was a field day for attorneys of both companies. Neither company wanted to do business under the conditions that the commission was recommending. So the matter was taken into the courts where a temporary injunction was issued against the PSC from holding hearings. The attorneys then asked for a hearing on a permanent injunction. That has been postponed indefinitely and no date has been reset.

Now, with Georgia P&L's rates reduced to last fall's levels, chances are that the whole matter will be dropped.

Home Use Hike of 370 Kwhr Is Puget's '54 Goal

"Target" of the Pudget Sound Power & Light Co this year is an increase in average residential use of 370 kwhr, which compares with a gain of 288 last year, Pres Frank McLaughlin told stockholders in the company's annual report.

The company's residential customers last year used an average of 5,223 kwhr, or about 2¼ times the national average, at an average rate of 1.3¢, or less than half the national average.

The year saw a "marked change in the basic factor which shape the company's destiny," said McLaughlin. "The 'sun came over the mountain' in 1953, giving Puget a 'new look' in the light of an improved 'climate' and of a new-found widespread appreciation of the company's intrinsic worth."

This "improved climate" is the result of a change in national power policy and public approval of the company's decision to continue on its own, without merger into the Washington Water Power Co or purchase by PUD's, McLaughlin believes. Threat of condemnation is over, he declares, with PUD's having "clearly recognized the unsoundness and costliness of piecemeal condemnation."

Market price of Puget's common stock has risen from a low of $8.50 per share in 1943 to a high April 7 of around $29 per share, the report points out.

Truth or Consequences to Run New Mexico Utility

The City of Truth or Consequences, N. Mex., and the Sierra Electric Co-op have reached a temporary agreement whereby the city will operate and maintain the REA system, Mayor T. B. Williams, announced.

At the annual meeting of stockholders of the REA, Fred McQueary, operations field representative of New Mexico and Arizona for the REA, said the co-op was $29,000 in arrears in repaying its loan to the federal government.

Since 1950, when the co-op's payments started becoming due, the local group has made only one payment on a loan of $598,000. Besides the $29,000 delinquent amount, additional payments of $15,000 will be due this year.

The firm has an estimated revenue of $61,000 for this year. McQueary said this would not be enough to pay operating expenses and still make delinquent payments.

Both the City Council and the REA board have agreed to the merger. Mayor Williams said the city utility department is adequately staffed and equipped to operate the REA Co-op. The city has agreed to operate the system on a cost basis.

PUD Sells Revenue Bonds

The Whatcom County PUD of Bellingham, Wash., has sold a $650,000 issue of electric utility revenue bonds to First Washington Corp of Seattle, bidding with Whipple & Co of Chicago, at an effective interest rate of 2.7756%. Four other bids ranged up to 3.4863%. Proceeds from the bonds, which will mature from 1956 to 1973, will be used for construction of a transmission line and substation to serve the PUD's first customer, a new General Petroleum Corp refinery at Ferndale.

FCC Sets June 16 Deadline on Radiation Device Briefs

June 16 is the deadline for filing statements or briefs with the Federal Communications Commission commenting on further proposed amendments to Part 15 of the Commission's Rules and Regulations Governing Restricted and Incidental Radiation Devices, (Docket No. 9288).

The notice states that studies seeking to establish radiation limits for electrical equipment, such as power, lighting and ignition systems, are inconclusive and that no specific radiation limits are proposed for them.

However, a proposed rule (15.6) states: "No incidental or restricted radiation device, irrespective of whether it otherwise operates in accordance with provisions thereof, shall be operated in a manner which causes harmful interference to any licensed radio service. Where harmful interference is in fact caused by the operation of any such device, its operation must cease immediately until the condition responsible for such interference has been eliminated."

The proposed rules define Incidental Radiation Devices as "Devices which radiate radio frequency energy but which are not specifically designed to generate radio frequency energy."

House Heating Section Is Organized by Nema

National Electrical Manufacturers Association has announced the formation of a new section which will be known as the Electric House Heating Equipment Section.

Scope of Nema's new section includes the following types of heating equipment principally used in houses:

1. Cable units for installation as radiant heating systems.
2. Radiant panels either of glass or other materials with, or without, integral component motors, thermostats, or other accessories.
3. Floor standing panels, or screens, which are adaptations of radiant panels suitable for operation at voltages in excess of 200 v.
4. Wall heaters, convection type, natural or fan forced for operation at voltages in excess of 200 v.
5. Floor furnaces, baseboard panels, electric steam radiators.

CONVENTION LEADERS at PUAA meeting at the Hub are (l to r, seated): Walter H. Sammis, president, EEI and Ohio Edison; T. G. Dignan, Boston Editon; (standing) C. Fred Westin, PUAA president-elect, Public Service E&G; Walter Heren, Union Electric, retiring president

Giving People the Facts . . .

. . . emphasized at PUAA annual meeting. Con Edison survey shows many people do not know that rates are regulated

Extreme importance of interesting the man in the street, his family, and friends in the personal value of business-managed utility service keynoted the 33rd annual convention of the Public Utilities Advertising Association May 13-14.

Boston welcomed 268 registrants to the meeting, including Walter H. Sammis, president of Edison Electric Institute. The sessions were conducted by Pres Walter G. Heren, Union Electric Co, who turned the gavel over to newly elected president, C. Fred Westin, Public Service Co of New Jersey, at the end of the meeting.

Sammis, who also is president of Ohio Edison Co, discussed the widespread opportunities of utilizing Light's Diamond Jubilee in driving home to the public the development of the industry as one of the nation's greatest assets.

Public Ignorant of Facts . . . C. B. Delafield, Consolidated Edison Co, cited popular suspicions of "bigness" in American industry as major targets for public relations work. He said a survey showed that 64% of the responders had no idea of how utility prices are regulated. Some 11% were aware of commission regulation, and of these, 82% favored private ownership.

Utilities backing appliance sales were advised to headline benefits to consumers as fundamental in sales drives. D. B. Armstrong, McCann-Erickson, Inc, stressed featuring "before" and "after" experience in contrasting advertising copy. He also said ads should focus attention on service of appliance types before expanding merchandising emphasis on brand products.

Appliance Demonstrations . . . Betty Furness, star of Westinghouse Electric Corp's Studio One TV program, emphasized importance of demonstration of appliance usefulness in the weekly telecast. She said constant effort is made to show how appliance users can obtain larger service for their various appliances while manufacturers, dealers, and distributors are cultivating the growing market for labor-saving and economical equipment.

R. H. Bridges, Cleveland Electric Illuminating Co, presented a report of the association's committee on advertising and public relations costs, of which he is chairman. The report, in pamphlet form, covered 156 electric and gas utilities and included data up to 1953. The report showed that in a five-year period, electric companies' average yearly advertising costs per customer have risen from 82 to 95¢. In terms of percentage of gross revenue, the costs fell from 0.62% to 0.59%.

H. M. Beville, National Broadcasting Co, New York, and Jay Heitin, TV Station WNBT, New York, delivered addresses on the fast-growing market for TV service. Prediction was made of at least 10 million color TV sets in use in this country before 1958. Average use of a TV set was reported at 4 2/3 hours a day.

Kits for Children . . . Work done to acquaint school children with utility developments is increasing. William Rogers, Pennsylvania Power & Light Co, showed Westinghouse's kit cardboard model of a modern steam plant for assembly in one to three hours. More than 8,085 kits have been sold.

Raymond Moley, Columbia University and "Newsweek" magazine, warned the utility industry against the encroachment upon private power industry of projects like the proposed irrigation-hydroelectric power development on the Upper Colorado River.

In connection with another controversial project—development of additional power at Niagara Falls—PUAA voted its approval of the "courageous and effective" advertising by General Electric Co and Westinghouse in favor of private development at Niagara.

(Story on new officers of PUAA appears on page 154).

FINANCIAL AID TO HIGHER EDUCATION

What Business Can Do to Help Our Colleges and Universities

Is the financial squeeze now gripping our colleges and universities grave enough to warrant direct action by the business community? If so, what can business do about it? This editorial is addressed to these two questions.

In the previous editorial in this series of two, it was demonstrated that **our colleges and universities, and particularly the independent institutions, face financial difficulties, which, unless relieved, promise to get progressively worse and might ultimately result in a national disaster.** This state of affairs obviously gives the business community a crucial stake in helping to relieve the plight of these institutions. For our business organizations can be no stronger than the total community of which they are a part.

It does not follow automatically, however, that every business firm should give direct financial aid to education. Already the business structure is heavily burdened with activities unrelated to its main purpose. These include acting as tax collector for more than $65 billion of federal, state and local taxes in the year 1953. There is a limit to the amount of such public enterprise that can be loaded on the business system.

Business Holds Key to Answer

If, however, the survival of a key part of our educational system depends on its having financial help from the business community, that help should be provided. And this is the situation of our independent privately endowed colleges and universities.

Of course, our tax-supported institutions of higher learning must also be kept strong, financially and otherwise. But they have recourse to public support not available to the independent institutions. Largely on this account, their present financial difficulties are much less acute than those of the independent colleges and universities.

These independent institutions have seen price inflation eat away much of the value of their endowments. Moreover, there is no prospect that these endowments can be sufficiently replenished by gifts from the wealthy people who provided them in earlier years. Progressive income and estate taxes have seen to that. Thus, they are faced not only with a peculiarly acute financial problem, but also one which cannot be solved except by tapping other sources of aid.

Tax Support No Solution

It is conceivable that the independent colleges and universities might solve their financial problem by seeking support from tax revenues. If they did this, however, they would lose their distinctive character as independent institutions, and our system of higher education would lose one of its major elements of strength. That is the existence in our educational system of both independently financed and tax-supported colleges and universities. Each has its special contribution to make to a well-balanced system of higher education.

Business is directly dependent upon higher education to staff its increasingly complex and exacting operations. A key part in this process is played by the small, independent liberal arts colleges which are the hardest hit financially of all our institutions of higher learning. "These," states the Council for Financial Aid to Education, recently formed by a group of business leaders, "have contributed a high proportion of the intellectual, scientific and religious, as well as business leadership of the nation. Their programs are devoted to the teaching of values, particularly the values of freedom. They are a vital bulwark to our system of free enterprise."

Means of Providing Help

There are many means by which business firms can extend help to our colleges and universities. The most obvious, of course, is to make outright grants of money either to individual institutions or to groups of institutions for such uses as the institutions think best. Another means of help, increasingly employed by business firms, is to establish scholarships to pay the full cost of college or university courses of study. Sometimes the scholarships are open for general competition, sometimes they are limited to employees and children of employees of the firm granting them. Not infrequently those winning the scholarships spend some part of their school vacations working in the companies granting the scholarships.

A number of companies have recently provided for what have come to be called "scholarships in reverse." These companies pay a flat sum to a college or university for every one of its graduates they employ. Financing of university research programs also offers a broad avenue for financial aid to our universities by business.

Need Two-Way Communication

Some business firms have well-developed programs for financial aid to education. But they are exceptional. For most companies the problems involved are new and strange. These companies were created with the basic purpose to make money, not to give it away. Successful philanthopic operations involve a whole set of problems with which they have very little experience. Not the least of these is how to make business a dependable source of financial aid to education, since business has no assurance that the profits of one year will not be losses the next.

Considerations such as these emphasize the wisdom of a recent Industry-College Conference on aid to higher education by business, in making the first of its ten conclusions that "better communication, by direct contact, is needed for each [industry and the colleges] to understand the problems of the other." At this juncture the creation of mutual understanding is much more important than the raising of some money and letting it go at that. The problem of aid to education by business has its immediate urgency, but there is also a long-range program to be developed on which business and the colleges and universities must pull together in the years ahead to find a satisfactory solution.

As stated at the outset, failure to find a satisfactory solution could result in a national disaster. This means that, **to give proper heed to their own future prosperity and the future welfare of the nation, business firms generally must go to work on the problem of financial aid to higher education. They must go to work first, to understand the problem; second, to establish two-way communication with our colleges and universities about it; and third, to develop a program which pays proper heed to the needs and capabilities of both business and higher education.**

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1	500	Whse.	1200	125/250	2300
1	500	Whse.	900	250	440
1	500	G.E.	720	125	2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing—425 lbs—750° F.T.T.—Surface Condenser 3/60/2300-4000 v with exciter
1	1000	G.E.	Non-Cond—190 lbs-2400-3-60
1	1000	Moore	Condensing—Extraction—190 lbs., 2400-3-60—Surface Cond.
1	750	G.E.	Condensing—265 lbs., 440-3-60 Built 1944
1	500	Moore	Non-Cond—150/200 lbs., 5/35 lbs. B.P., 480-3-60 Dir. Conn. Exciter.
1	300	G.E.	Non-Cond—150/175 lbs., 5/10 lbs. B. P., 480-3-60

FREQUENCY CHANGERS

Qu.	Kva	Make	Cycles	Voltages
1	13900	Whse.	60/25	13200 x 13200
1	3750	G.E.	60/25	4150/2400 x 2400/4150
1	3125	G.E.	25/60	4150/2400 x 2400/4150
2	2500	G.E.	25/62½	2300 x 4150
1	1250	G.E.	25/58.3	4400 x 2300
1	625	A.C.	25/60	11000 x 2300

TRANSFORMERS—60 Cycle

KVA	Make	Type	Ph	Voltages
1—5000	Whse.	OISC	3	33000x26400/13200
1—2500	Whse.	OISC	3	26400/13200 x 480
3—2000	G.E.	HVDDJ	1	66000 x 13200
1—1500	G.E.	HT	3	13200 x 2300
3—1250	G.E.	HVDDJ		6600/550
3—1000	G.E.	HVDDJ	1	2200/480

BELYEA COMPANY, INC.
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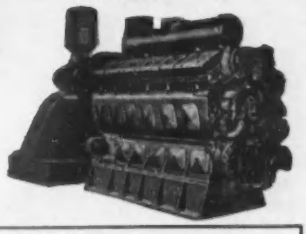
DIESEL POWER



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UNIT CAPACITIES—10 TO 2475 KVA
A.C.—50 AND 60 CYCLES
• ALSO D.C. UNITS

A PARTIAL LISTING OF OUR INVENTORY

KW	Make	Model	HP	RPM	KW	Make	Model	HP	RPM
1180	Worthington	SEH-8	1685	360	400	Ingersoll-Rand	8-8	600	720
1136	Fairbanks Morse	38D	1600	720	350	Baldwin	VO-6	510	450
1100	General Motors	16-278A	1600	720	320	Enterprise	D8G-6	560	450
750	General Motors	12-567	1080	720	300	General Motors	8-268A	450	1200
700	Worthington	EE-8	1000	327	280	General Motors	8-268A	350	900
500	General Motors	8-278A	750	720	150	Worthington	CC-4	225	450
500	General Motors	8-567	720	720	150	Ingersoll-Rand	8-4	225	600
500	Alco	6-12 1x13T	750	600	150	Buckeye.	80	240	600
480	Worthington	DD-8	700	360	100	General Motors	3-268A	150	1200
400	Sterling	VD8-8	600	1200	60	General Motors	6-71	90	1200

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DIESEL DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

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TRANSFORMERS
2— 750 KVA G.E., 3 Ph., 4150V. 120/240V. sec.
2— 750 KVA G.E., 1 Ph., 4600V. 115/230
2— 400 KVA Pitts., 1 Ph., 2400/4800V. 240/480V.
3— 333 KVA Whse., 1 Ph., 2400V. 600 V. sec.
2— 300 KVA G.E., 1 Ph., 13200V. 220/440V.
1— 200 KVA G.E., 3 Ph., 2400-220 sec.
3— 200 KVA G.E., 1 Ph., 13200V. 440V.
1— 200 KVA G.E., 3 Ph., 4150V., 3 Ph. 2400V. Auto.

SYNCHRONOUS MOTORS
1— 350 H.P., Elec. Mach., 720 RPM, 3 Phase 60 cyc., 2200V T E F Coated Outdoor service.
1— 150 H.P., G.E., 1800 RPM. 220V. 3/60.
2— 150 H.P., Al. Chal. 360 RPM. 440V. 3/60.

MOTOR GENERATOR SETS
1—1000 KW Whse., 600 V. 720 RPM. 4600 syn.
1—1000 KW G.E., 800 V. 514 RPM. 4000 Syn.
1—1000 KW Whse., 275 V. 720 RPM. 4000 Syn.
1— 200 KW Whse., 250V., 900 RPM. 4000V. Syn.
1— 150 KW G.E., 125/250V. 1200 RPM. 2300 Syn.
1— 100 KW G.E., 250V. 900 RPM. 2300V. Syn.

SLIP RING MOTORS
2— 500 H.P., G.E., M 1200 RPM 2400V.
1— 400 H.P., West., CW. 450 RPM. 550V.
1— 250 H.P., West., CW. 600 RPM. 440V.
1— 200 H.P., West., CW. 600 RPM. 440V.
3— 150 H.P., Al. Ch. 1800 RPM. 2300V., 3PH. 60 Cy.

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2709 Richmond St. El Paso, Texas

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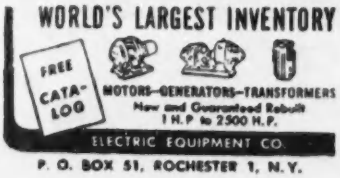

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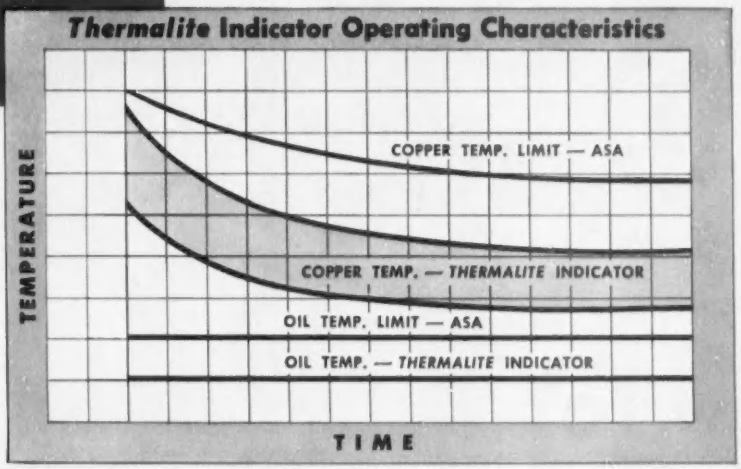
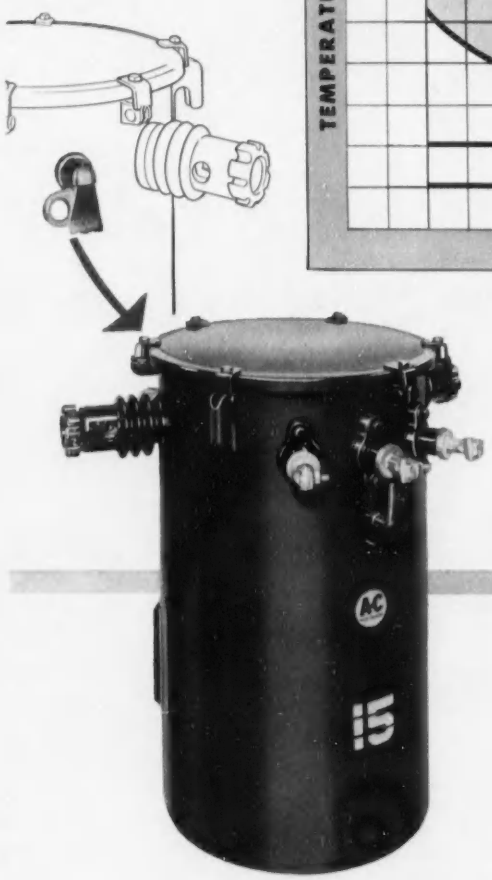
Take advantage of your system's inherent overload capability





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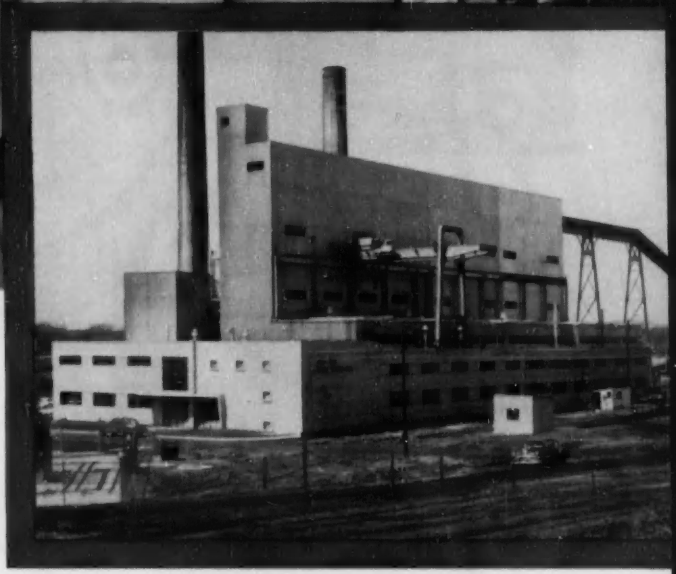

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